MACHINERY

March, 1909.

ORGANIZATION AND EQUIPMENT OF AN AUTOMOBILE FACTORY.

CONSTRUCTION AND DESIGN OF THE PRODUCT.

C. B. OWEN.*

THE Leland, Faulconer & Norton Co., of Detroit, Mich., was formed in 1890 for the purpose of building machine tools and special machinery. The incorporators were H. M. Leland and C. H. Norton of Worcester, Mass. (both of whom had been with Brown & Sharpe for many years), and R. C. Faulconer and C. A. Strelinger of Detroit. Special milling machines, a lathe center grinder, a well-known wet tool grinder, and some special machinery were built. Later the manufacture of wood trimmers for pattern shop use was undertaken; and next, during the development

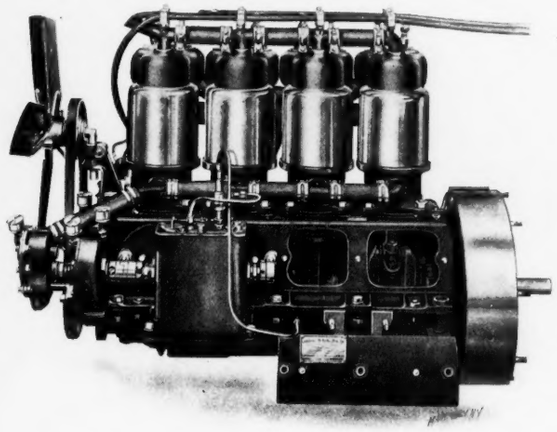


Fig. 1. Left Side of Cadillac 30-horse-power Engine.

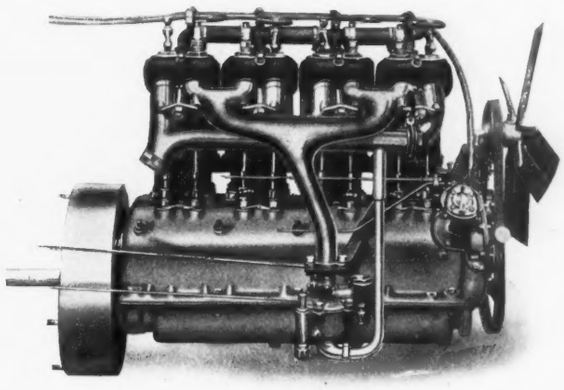


Fig. 2. Right Side of the Engine, showing Carburetor, Commutator, etc.

period of the bicycle industry, a line of machinery for making hardened and ground bicycle gears was developed. As the bicycle business declined, the company began building gas engines for motorboats, which were then rapidly rising in popularity. Mr. Norton severed his connection with the company in 1894, and returned to Worcester, where he later became interested in the Norton Grinding Co. A large foundry was completed in 1895, which has run steadily ever since, doing a large outside business.

The natural step from the marine to the automobile type of gas engine was made in 1901 to 1902, when the motor now used in the Cadillac car was produced. The firm's previous experience enabled it to build an engine which was thoroughly standardized and accessible for adjustment or repairs and for the replacing of worn parts. A stock company formed by Detroit business men about this time for the manufacture of automobiles, made arrangements with the Leland & Faulconer Co. to build the engines. The car made its first public appearance in September, 1902, at the time the city was celebrating its bicentennial, and the car was called the "Cadillac" in honor of La Mothe Cadillac, who founded the city in 1702. In 1904, Mr. Leland was made general manager of the Cadillac Co., and in the next year the stock of the Leland & Faulconer Co. was absorbed and both plants united to form the present Cadillac Motor Car Co. From 1902 until the present time about 21,000 cars have been turned out, 17,000 of which were single cylinder 10 H. P. machines, and the rest four cylinder cars, rated at 30 H. P.

The first automobile, made in 1902, was a runabout containing a 10 H. P., single cylinder, four cycle, horizontal engine, of 5-inch bore by 5-inch stroke. This engine was found to be so satisfactory that it has been retained practically unchanged up to the present time, and its general features have been adopted, so far as possible, for the vertical four cylinder engines of the 30 H. P. machine. A number of original features were employed on this engine which have proved their value in actual practice. One of the most interesting of these is the cylinder construction, best seen in Fig. 9. This cylinder, which is a fine-grained gray iron casting, has a flange near the forward end, which enters and fits a bored and faced seat in the frame. The copper water jacket slips over the cylinder, and is flanged to match its outer face. Both it and the cylinder are held in place by a ring which passes around the outside of the copper jacket, and is tightened down by the studs shown screwed into the frame. In this way the copper jacket forms its own gasket. The cylinder head or valve chamber is held in place by a hollow steel nut (or nipple, rather) which is threaded externally right- and left-hand, and screws into both the cylinder and the valve chamber. The upper end of the copper jacket is clamped between the two, and thus serves for a gasket at this joint also, forming the only packing needed. Parts are kept in alignment by a dowel, and suitable openings connect the jacket space of the cylinder and the head. Among the advantages of this construction over the usual cored jacket are lighter weight, greater water space, more uniform thickness of cylinder walls, facility in cleaning the jacket space, elimination of trouble from freezing the cooling water, and low repair cost for broken parts.

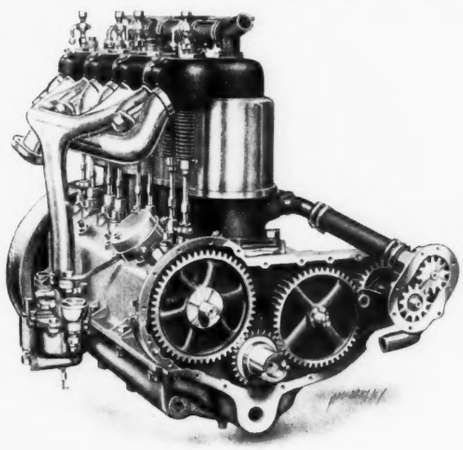


Fig. 3. Front View of the Four-cylinder Engine.

The exhaust valve is placed in the cylinder head with its axis vertical, and it is operated from the cam shaft by a push-rod and bell-crank. The inlet valve is of the inverted

* Address: 857 Lincoln Ave., Detroit, Mich.

type, located directly above the exhaust valve. It is operated by a lever with a roller on its outer end which, in turn, is actuated by a push-rod riding on a roller mounted on one arm of a short lever. The push-rod is connected with an eccentric on the cam shaft. The lever on which it rides is under the control of the driver, so that the timing of the valve and the amount of lift may be varied according to the work required. The throttling is thus effected by the inlet valve gear. The carburetor (shown in Fig. 10) is formed in one piece with the inlet valve mechanism. As may be seen, the inrush of air lifts valve *M* and allows the escape of the oil, which falls into the wire mesh basket *K*, where it is vaporized. The lift of the valve may be regulated to give the desired richness of mixture.

The motor frame is made in three parts—the frame proper, and the top and bottom plates. The main shaft, which is offset, is a nickel steel, center-crank forging, finished all over by grinding. It is carried in babbitt lined bronze bearings, fitted in bored and reamed seats in the motor frame. These are held in place by cap plates, which can be adjusted without opening the motor. The cam shaft is carried in bronze bushings inserted in the bottom plate. This plate and the cam shaft may be removed at any time without disturbing the crank shaft.

The transmission of the 10 H. P. machine is of the planetary type, providing for two speeds forward and a slow reverse. As shown in Fig. 11, the gearing is all enclosed in an oil-tight casing. On the high-speed forward gear the whole transmission revolves as a unit. The driving pinion is of 40 point carbon steel and is case-hardened, as are also the idler pinions, which have bronze bushings pressed into them after hardening, and run on hardened and ground pins pressed into the gear case. Power is transmitted to the rear axle sprocket by a Whitney roller chain. An assembled view of the engine is shown in Fig. 8.

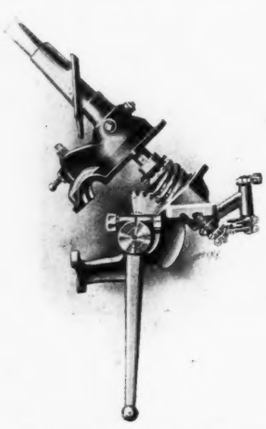


Fig. 4. The Cadillac Steering Gear.

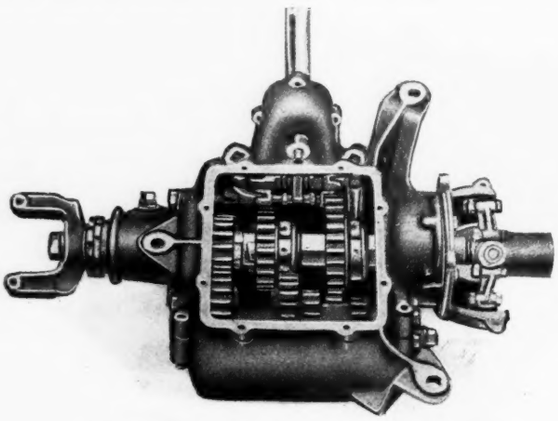


Fig. 5. Selective Type Sliding Gear Transmission.

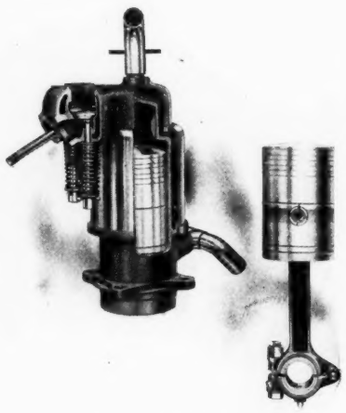


Fig. 6. The Cylinder and Piston.

The later vertical four cylinder engine for the 30 H. P. machine is shown in Figs. 1 to 7 inclusive. This engine has been built, as far as practicable, on the lines of the horizontal machine. As may be seen in Fig. 6, the same arrangement is used for clamping together the cylinder, the copper jacket and the cylinder head, although a somewhat different joint is used at the lower end of the jacket. In this engine also the crank-shaft is offset; the construction of the crank case and base is different, of course, as shown in Fig. 7. A leather-faced cone clutch in the fly wheel transmits power to the sliding gear transmission (see Fig. 5) which gives three speeds forward and one reverse. The gears and shafts are of oil-treated chrome-nickel steel, and are carried on ball bearings. The gear case is oil-tight, as is also the universal joint housing and the rear axle casing. The rear axle carries an oil-treated chrome-nickel steel bevel gear and pinion, and the gear mounts are adjustable for wear of the teeth. The steering gear (see Fig. 4) is of the worm and sector type, treated in the same ways as the transmission and differential gearing.

The Plant and its Organization.

The main or Cadillac plant is located on both sides of Cass Ave., and has a double siding connected with the Belt Line Railroad, thus giving ample shipping facilities. The factory buildings are of brick and reinforced concrete construction, lighted by large windows. Heat is supplied by a live steam system. The boiler-room contains three water tube boilers, with room for another if it is needed. Light and power are furnished by electric current supplied by the Detroit Edison Co. Electric driving is used throughout the plant, with motors connected with each line shaft, and occasional installations with direct connected tools. A large compressor furnishes air at 125 pounds pressure for the penumatic hammers in the frame department, and for use in the various assembling departments, for cleaning parts, running air drills, etc. Five large elevators in fire-proofed brick shafts convey materials and parts between the various floors. An automatic sprinkler system is installed, supplied by four tanks on the roof. These tanks are filled by a large fire pump which operates whenever the level of water in the tanks is reduced. This same system supplies water for lavatory and wash-room use. There are two large wash-rooms, each having 600 bowls and 1,000 lockers. Soap is furnished by the factory.

The old Leland & Faulconer plant comprises a foundry building of brick, steel and glass, supplied with cupolas and a hydraulic jib crane; a pattern shop and pattern storage building; a brass foundry building; a brick building for the case-hardening department; and a large three-story brick building for the power plant and the sheet metal and brass working departments. The building is lighted by both gas and electricity, has a hot air heating system, and is provided with large wash-rooms on each floor.

The organization of the plant is divided into the following departments: First, the general manager; second, the secretary; third, the sales department; fourth, the advertising department; fifth, the purchasing department; sixth, the time-keeping and cost-keeping department; seventh, the superintendent and his assistants; eighth, the engineering and designing departments, who produce the new models, tools and fixtures, and in conjunction with the experimental department, test the new cars before placing them on the market; ninth, the foremen and their assistants in the forty-four manufacturing departments; and six other special departments, some of which will be mentioned later. While the reader will be most interested in the departments devoted strictly to manufacturing, the work of the engineering and purchasing departments is worthy of some notice.

The designing-room is separate from the general drawing-room and is used by the chief engineer and two designers. Suggestions for new designs and improvements in old ones may be made by any one on suitable blanks. They are all considered and passed upon by a mechanical committee, consisting of the general manager, the chief engineer, and the two designers. When approved, such changes are made immediately on the tracings, and new blue-prints are made and sent to the departments concerned in producing those parts. This keeps the blue-prints up-to-date, and avoids loss in the carrying through of parts of obsolete design. A well-organized experimental department is provided, having the necessary apparatus for testing new designs. The work

of the general drawing-room includes the detailing of new designs, and the drafting work on the necessary tools, gages, jigs and fixtures needed to produce new parts or models. Filing cabinets are provided for current drawings, as well as for those which are obsolete, of which a full record is kept.

The Purchasing Department, the Stock-rooms and the Gasoline Storage.

The purchasing agent has final authority on all matters concerning the actual buying of material used in the cars, and the care of this material until it goes to the machine or assembling departments. Purchasing orders are made out in quadruplicate. One copy goes to the seller, one to the receiving office, one to the bookkeeping department, and one to the file in the purchasing office. Small commercial parts, such as nuts, rivets, etc., are stored in bins in the general

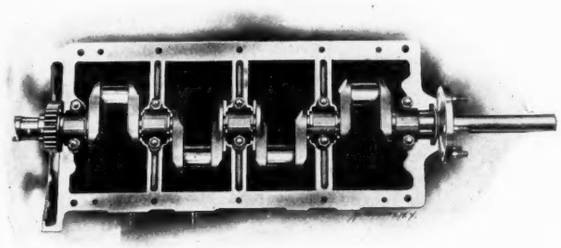


Fig. 7. Top View of Motor Case and Crank-shaft.

stock-room, which also receives the finished and inspected parts turned out by the manufacturing departments. The stock-room record is kept on a card index system, and material is delivered by the stock keeper only on presentation of a requisition from the foreman of the department where it is to be used. Bulky parts and materials are kept in a large warehouse, which is also under the care of the purchasing department. A separate stock-room is required for repair parts. These are kept in stock for all models, clear back for the first one placed on the market, and they are replaced as fast as sold out.

The gasoline used in testing the cars is also considered as stock, and a very carefully planned storage system is provided for it. Four cylindrical tanks of 15,000 gallons capacity each are buried in concrete near the siding, with the tops of the tanks about five feet below the street level. They are connected at top and bottom by separate cross piping.

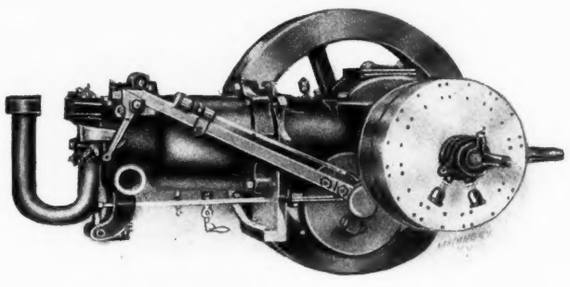


Fig. 8. The 10 H.P. Engine of the Single-cylinder Car.

The system of storage is such that these tanks are always full of water or gasoline, or both, so that air is always excluded, making explosion impossible. The upper cross pipe permits the free passage of gasoline between the tanks, while the lower pipe performs the same function for the water. A suitable arrangement of automatic valves lets in water as fast as gasoline is removed, or permits the escape of water as gasoline is introduced.

A notable safety provision in the outlet piping for the water, positively prevents the escape of gasoline into the sewer. The outlet pipe is formed into a long U-bend, which extends vertically to a depth of 70 feet, inside of an 18-inch casing. From this it returns and discharges through a trap into the sewer. The depth of this bend is such that the column of water on the outlet side will balance a column of gasoline having a height corresponding to the head obtainable from a tank car on a grade 5 feet higher than the present siding. The water thus furnishes a permanent seal against the discharge of gasoline.

The distribution of the gasoline is also carefully safeguarded. It is supplied to the various testing rooms and to the factory garage through piping from the storage system. It is retailed by Bowser registering pumps which are kept locked when not in use. As a further safeguard, all the piping is enclosed in concrete, and the whole system is so arranged that it may be flooded with water to a depth of five feet in case of fire in any building which might later be built over it.

Tool and Tool Supply Departments.

The tool department is located on the top floor and at the north side of the building, where the best light is obtainable. It is devoted to the manufacture of the jigs and fixtures and many of the gages employed in the factory. The equipment consists largely of Reed and Hendey & Norton lathes, Hendey shapers, Brown & Sharpe milling machines, and Brown & Sharpe universal and surface grinders. The high degree of interchangeability required in the product demands a high standard of workmanship in this department. At the time Fig. 12 was taken, some manufacturing was being done here. A wire enclosure at the right contains the tool inspecting department. The tool steel stock and tool grinding rooms are at the further end of the picture.

The tool supply department is closely allied with the tool-room. Its work is principally that of caring for, sharpening and recording the various jigs, fixtures and cutting tools. All these tools are looked out for by a card index system,

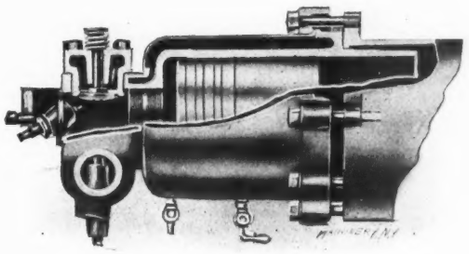


Fig. 9. Section through Cylinder showing the Water Jacket Construction.

which shows where they are used, and what repairs if any have been necessary. This department orders all the small commercial tools, and keeps a debit account with each branch tool-room for the supplies furnished it, giving credit for all tools worn out in legitimate use or broken in unavoidable accidents. A perpetual inventory is thus kept of all the special and commercial tools kept on hand. A card index inventory of the machine tools is kept in the purchasing department.

Forge, Foundry and Sheet Metal Departments.

It will not be possible to more than briefly mention that part of the equipment of the forty-four manufacturing departments, which is concerned with the actual work on the parts. The blacksmith shop is small, owing to the extensive use of drop forgings, but it is finely fitted up with Buffalo down-draft forges, a tool forge with a coke magazine, gas furnaces, water jacketed dipping tanks, and an electric welding machine. The bulk of the work consists of tool dressing, and the making of forgings for jigs and fixtures and for special car equipment. The case-hardening department has ten large Frankfort gas furnaces equipped with pyrometers, connected by a switch-board with a galvanometer reading to degrees Fahrenheit. Oil and water dipping tanks with steam and cooling water jackets are provided. These are piped to a steam pump to give positive circulation. Square and oblong pots are used for small machine parts, while round pots with central holes, to insure uniform heat, are used for the large rear axle bevel gear.

The iron foundry is provided with a large and a small cupola. The latter is used largely for heats of a special

nature. The most approved methods for testing and chemical analysis are employed to keep track of the output. This is necessitated from the fact that the foundry furnishes castings for other motor car builders besides the Cadillac Co. The brass foundry furnishes the necessary castings for the bronze bushings, carburetor and lubricator parts, small valves and fittings, etc. These are finished in the brass machine shop, which is equipped with forty Warner & Swasey screw machines, besides several Fox lathes, drill presses, milling machines and several special lathes. All the lubricators, gasoline valves, carburetors and bearings used are produced here.

In the sheet metal department are made the vertical tubular radiators, gasoline tanks, dashes, fenders, etc., as well

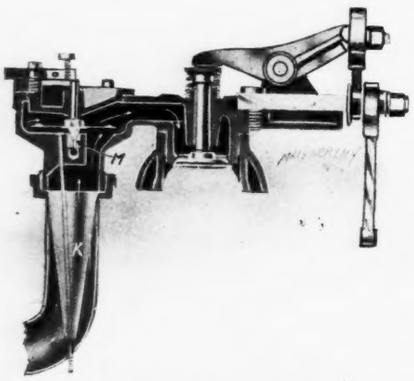


Fig. 10. The Cadillac Carburetor.

as small punchings, such as washers, clips, etc. The press-room has a complete equipment, ranging from foot presses up to 20 ton power presses, capable of cutting and forming parts up to 36 by 48 inches. Gas furnaces are used for heating the soldering irons and work when assembling the radiators. The radiators and tanks are tested by compressed air while submerged in water. The frame department is equipped with gas furnaces and pneumatic hammers for riveting and heading.

Equipment of the Machine Departments.

For convenience in handling the work, all the engine parts are drilled and milled in two separate departments in one large room, while the similar operations on the chassis parts are performed in another room, which is shown in part in Fig. 13. The equipment of this department includes a large number of Cincinnati drill presses, Cincinnati and Brown & Sharpe milling machines, and a Beaman & Smith cylinder boring machine, arranged for handling transmission cases and axle housings. The engraving shows the large use of multiple spindle drills, quick change drill sockets and jigs.

The equipment of the motor drilling department is somewhat similar, ranging from a sensitive bench drill to a 24 spindle motor-driven Baush machine. This is used in drilling the 24 holes for studs, cap screws, etc., in the lower half of the motor frame. These holes are all drilled at one time, and have to accurately match similar holes in the upper half. This, it will be seen, requires a high grade of workmanship. The milling department for motor parts employs several Whitney hand millers, Brown & Sharpe horizontal millers of various sizes, several vertical machines of the same make, and six heavy motor-driven Cincinnati machines. There are also to be found here two milling machines built by Leland & Faulconer, which are unusual in that the table has longitudinal and cross feeds only, the vertical adjustment being applied to the spindle. High-speed steel inserted tooth cutters are in general use.

The screw machine department is one of the largest in the factory, occupying a floor space of 80 by 200 feet, and containing 62 machines, exclusive of the tool grinders. Brown & Sharpe, National, Acme, Davenport and Cleveland machines are used for making cap screws, nuts, studs and other parts up to one inch in diameter. Gridley machines are employed for larger work. Jones & Lamson flat turret lathes are used for shafts, spindles and some gear blanks. The Potter & Johnston automatic machine is employed for much of the chucking work in combination with the Gisholt and Steinle machines, which are used mostly for machining clutch and gear mounts. A group of Bardons & Oliver machines are used on certain engine parts, which have to be held in face-plate fixtures and finished largely by hand labor. The larger Acme machines are direct connected.

While most of the round parts are finished complete on the screw machine, a lathe department is necessary for some work which has to be turned on arbors. Fly-wheels and some long axle shafts are also finished here. The equipment includes Reed lathes, a Bullard boring machine for finishing fly-wheels, and two Beaman & Smith double-spindle horizontal boring machines for roughing out the cylinders. The latter are similar in design to that described in the department of New Machinery and Tools of the October, 1908, issue of MACHINERY, being provided with turntable fixtures, so that two cylinders may be set up while two others are being bored. After the cylinders are roughed out, they are tested under hydraulic pressure and sent to the grinding department.

The grinding department finishes practically every round part on the car except the crank-shaft, which comes finished from a firm making a specialty of that work. Heavy Norton and Brown & Sharpe grinders are used for finishing long parts. Medium sized Landis and Brown & Sharpe grinders take care of work up to 3 inches in diameter and 8 inches long. Special Brown & Sharpe and Heald grinders are used for finishing the cylinders, which are held exactly as they will be on the assembled engine, so that clamping strains are duplicated. The pistons are finished in one of the heavy Norton machines. The group of Heald machines is used exclusively on internal work, and an equipment of face grinders finishes the washers and flat disks used in the cars. The square shafts which carry the sliding members of the transmission are ground to size on a group of Brown & Sharpe surface machines, fitted with suitable index fixtures. In contrast to the heavy Norton grinders with their 24-inch wheels, is a bench grinder purchased from the Waltham Watch Tool Co., for finishing internal ball races. This little machine uses a wheel about the size of a five-cent piece, and may be set to grind to a radius of ⅛ inch. Careful attention is given to providing suitable racks for ground work to avoid injury in handling.

In Fig. 14 is seen a partial view of the gear-cutting department. A Gleason bevel gear generating machine is here shown

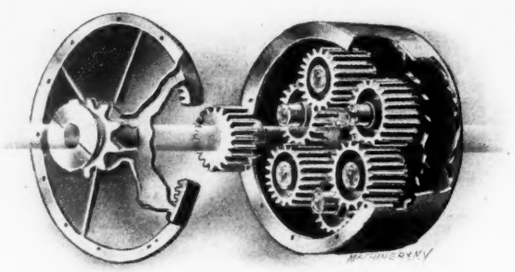


Fig. 11. Planetary Transmission used on the Single-cylinder Engine.

at work cutting a rear axle gear. The complete equipment includes thirty standard machines, and four others of special design, besides four testing machines. The list includes fifteen Brown & Sharpe automatic gear cutters, one large Gould & Eberhardt machine, two Fellows gear shapers for internal gears, one Bilgram and three Gleason bevel gear planers, two imported French machines for special pinion work, and a Pratt & Whitney worm milling machine. One of the testing machines, that for bevel gears, is seen at the extreme right of Fig. 14. The testing machine for spur gears is provided with a vernier scale for reading center distances to thousandths of an inch.

Inspection and Assembling Departments.

The inspection department consists of a chief inspector and his foremen, and the men under them, who together form a corps of over one hundred men. These men inspect commercial parts as they go through the receiving department, the output of each manufacturing department as it goes to the

assembling, the final assembling of the parts in the chassis, and the finish of the completed machine on both the mechanism and the body. The inspectors are furnished with all necessary appliances for doing this work accurately. Drop forgings are examined for visible flaws, and sounded for invisible ones. Springs are tested on machines especially built for the purpose. Every machine department has its inspection bench, provided with the necessary plug and snap gages for the entire range of its output. Micrometer calipers up to the 6-inch size are in general use. Thread micrometers are used in place of ring thread gages wherever possible. For testing turned and bored parts for concentricity, Brown & Sharpe testing centers and indicators are used. Suitable surface plates, V-blocks and height gages are provided. The inspectors in the grinding department are furnished with strong reading glasses for use on certain work. These inspectors are outside the jurisdiction of the other department-heads, and have full authority to throw out all parts and materials not up to the standard.

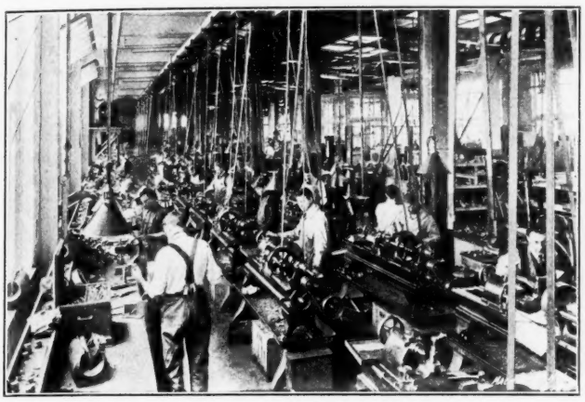


Fig. 12. A Partial View of the Tool-making Department.

Fig. 13. The Chassis Drilling and Milling Departments.

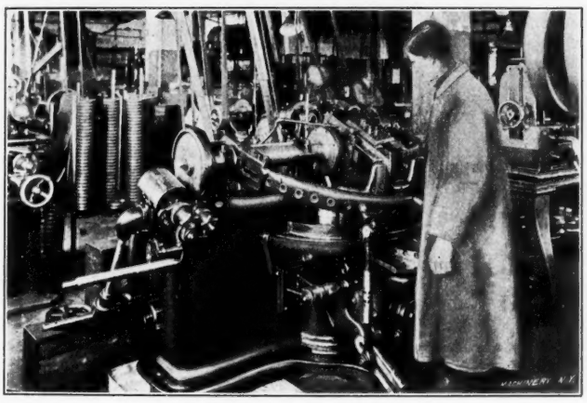


Fig. 14. A Corner of the Gear-cutting Room.

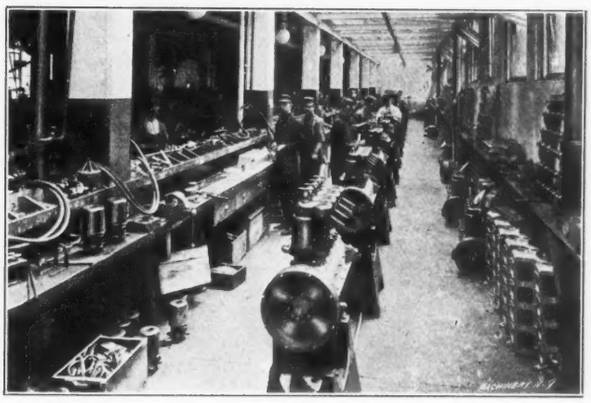


Fig. 15. The Four-cylinder Engine Assembling Department.

The work of assembling is divided between several gangs, each of which does its own particular work. One group of assemblers scrapes the crank-shaft bearings to fit, and "runs them in" by a belt on the fly-wheel. Another assembles the cam-shaft members. Still another assembles the piston, its rings, pins, connecting rod and bearings, while the "cylinder gang" assembles the cylinder and cylinder head and copper water jacket. The final assembling is then done on stands as shown in Fig. 15. This consists merely in bolting the various parts together, setting the cam gears (which are marked in a jig), timing the valves, adjusting the bearings, and testing the water connections. The points of valve opening and closing are marked on the rim of the fly-wheel, and a fixed pointer shows the central position.

The Testing Department and its Equipment.

From the assembling room the engines are taken to the testing department, where they are placed on iron stands and connected with the gasoline and water supplies, and to the electrical connections for the ignition, which are shown plainly in Fig. 16. The engines are run at moderate speed until they get down to work, when the speed is gradually brought up to the maximum. A brake-horse-power test of each engine is made, and those which fail to come up to the requirements are returned to the assembling department for reconstruction. As a check on this test, stock engines are sent to the experimental department at regular intervals, and tested there by connection with a dynamo fitted with suitable electrical measuring instruments. After the testing the engines go into stock, or to the chassis assembling department.

All the parts necessary for the completed chassis are brought to this assembling department. The order of assembling is as follows: The frames are first laid on horses and the mechanism dust shield is put on. The springs and axles are next attached, and then the engine and transmission gearing are set and lined up. The engine is supported at three points, and is connected by a universal sliding joint with the transmission gearing, thus permitting weaving of the frame without danger of disalignment. The universal joint between the transmission and the differential gearing is practically straight when the car is loaded, and runs at a very slight angle when the car is light. The exhaust pipe and muffler are next connected, and then the controlling and brake levers and the pedals. The radiator and water connections come next, followed by the steering gear. The placing of the mahogany dash in position permits the mounting of the electrical apparatus; and the bolting on of the gasoline tank and its connections completes the chassis, except for the wheels and tires. An old set of these are put on the car in the assembling department, to be used for the road test. The method of assembling is practically the same for the single cylinder car.

Two separate testing departments are provided—one for the single cylinder cars, and the other for the four-cylinder cars. The former were given road tests for the first two years of their manufacture, until all the weak points in the construction had been eliminated. The testing-room shown in Fig. 17 was then built, and the cars have since been tested here. Fifteen stands are provided. The rear wheels rest on a pair of 48-inch pulleys, mounted on a shaft which carries a fan about 72 inches in diameter by 36 inches wide, projecting through the floor in the sheet iron casing shown. In addition to the resistance thus offered by the fan, a brake is mounted on the shaft between the pulleys, controlled by the hand-wheel

on the stand shown projecting through the floor at the rear of each machine. By this means it is possible to work the engine against any desired resistance, even to the extent of stalling it. The chassis are held by padded hooks, fastened by ropes or chains to the brake wheel stands. The blast of air produced by each fan is led through a sheet metal conduit and directed against the radiator of the engine, thus giving the same cooling effect that would be experienced at corresponding speeds on the road on a still day. The speed in miles per hour is read from Schaffer & Budenburg tachometers.

The four-cylinder testing stands are similar in principle, though somewhat differently arranged, as the fans are placed beneath the front of the machine, being connected with the driving shafts by sprockets and chains. After being run here a sufficient time to make sure of their adjustment and running condition, temporary bodies are placed on the chassis and each car given a thorough test by reliable men on the country roads outside the city. After this has been done to the satisfaction of the foreman of the department, the testing body is removed and the chassis is washed successively in water and gasoline, and dried by an air jet.

Fig. 16. Testing the Four Cylinder Engines.

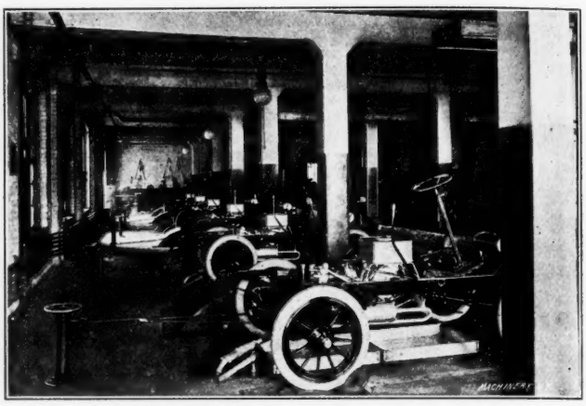


Fig. 17. The Single Cylinder Chassis Testing Stand, arranged for Fan and Brake Resistance.

Fig. 18. The Body Trimming Department.

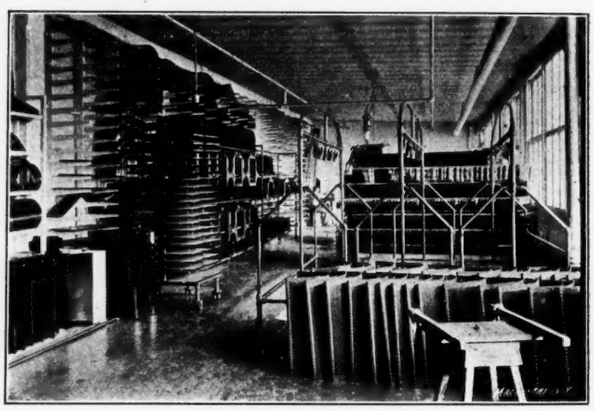


Fig. 19. Storage of Enamelled Parts, showing Wheeled Stands used in the Baking Ovens.

Finishing.

The painting and finishing of the chassis, bodies and wheels is done in separate departments. The bodies receive one coat of rough filler, and fifteen more coats of filler color and varnish, before completion. A view of the trimming departments for the bodies is shown in Fig. 18. Fenders, hoods, brackets, etc., are enameled and baked. Fig. 19 shows some of the pipe frame trucks used to hold these sheet metal parts during the baking.

The chassis, bodies, hoods, fenders, etc., finally go to the large finishing-room on the ground floor, where the final assembling and testing of the complete car is done. Each complete car is driven out by a final inspector to make sure that all adjustments are correct. Before shipping, a detailed record is made of each car, beginning with the motor number, and giving the dates of motor assembling, motor testing, all the various painting, finishing and shipping dates, together with any information of a special kind, such as size and color of body, etc. This record has been found of the greatest assistance to the repair order department in filling poorly written orders.

Interchangeability.

In connection with this subject of repair orders, mention should be made of the high degree of interchangeability attained by the Cadillac Co. This was illustrated by a test made last March by a committee of the Royal Auto Club of England, who selected by lot three Cadillac cars of the same 10-horsepower model, disassembled them under the eyes of an inspector of their own appointment, placed the disassembled parts (721 from each car) in a pile, and mixed them up indiscriminately, 81 parts were then taken out and replaced by 81 repair parts from stock. The cars were thereupon reassembled from this mixed pile by the use of wrenches, screw-drivers, etc., but without the use of scrapers, files or even emery cloth. Only one part, a cotter pin, was injured in reassembling. These three heterogeneously reassembled cars were each given a 500 mile reliability run on the Brooklands track, at an average speed of 33 to 34 miles per hour, without developing the slightest defect. This test speaks well for the organization of the factory.

The whole Cadillac plant is now devoted to the production of the four-cylinder, 30-horse-power car, the "Model 30" as it is called. The machine departments are run twenty-two hours a day, employing a total of 3,000 men in all departments. Thirty-six complete cars a day are produced.

* * *

So-called black oil finish on steel may be produced in several ways, but the *Brass World* states that the following method is one of the best. The article to be finished is heated in a furnace to a cherry red heat, and is then plunged into lard oil. It is immediately removed, and the oil is burned off in the furnace. When this has been done, the object is immersed in water. After the immersion in water, the surface of the steel will be black and will not rust. In order to bring out the best surface, a light film of linseed oil may be applied to the article after it has been removed from the water.

GEOMETRICAL PROGRESSION FOR SPINDLE SPEEDS.

FRANCIS W. SHAW.*

The utility of the data sheet table of geometrical progressions for spindle speeds, published in the November, 1908, number of the engineering edition, is unquestionable, but in the writer's opinion, it is not confined to the use suggested by the author. I have now had several years' experience in the use of a similar table, and have designed many gear systems, but I have never yet been able to make use of its labor saving properties in getting out a series of speeds in geometrical progression, except as will be described herewith. The required speeds have never happened to correspond in their percentage of decrease with any of those given in the table.

The chief use I have made of the table is to find roughly the percentage of decrease, which is done as follows: A pair of dividers is set so that the points span a distance from 1 in the "Number of Speed Changes Required" column to the number corresponding to the number of speed changes required —say, for example, 16. Having decided upon the maximum and minimum speeds, the dividers as previously set are used to find in the percentage column, by trial, two speeds 16 spaces apart, which most nearly correspond with those required. The tables, from my point of view, would have been much more useful had the differences between the adjacent columns been smaller, say ½ per cent.

In designing a speed-varying mechanism for a machine tool drive, it is usual to consider first what limit speeds are necessary to meet the requirements of the work, then the number of speeds. As a matter of fact, however, the latter point is usually governed by some set design already applied, it may be, to other sizes of the same class of machine. Oftentimes, the productions of our competitors cause us to draw the lines a little wider, as we must have as many talking points as possible.

Having decided the points enumerated and chosen the limit speeds, there appears to the writer no good reason why they should not be adhered to; why be content with an approximation when to secure the ideal is so simple? The difficulty of applying the table has been admirably obscured by the author in the example quoted, by taking 250, an aliquot part of 1,000, as one of the limit speeds. Had he chosen, say 346, as the highest speed, he would have been under the necessity of multiplying each number by 0.346. To do this operation for, say 16 speeds, would involve practically as much labor as to arrive at the result by the logarithmic process. A method by which any reasonably simple geometrical progression can be found in less than half an hour, is shown in the following working of a suppositious example. The requirement is 16 speeds varying from 6.5 to 270 R. P. M.. To find the common ratio, *i. e.*, the number by which 6.5 must be multiplied to produce the second speed, and by which the second or any other speed must be multiplied to produce the next higher speed, it is necessary to use the well-known formula, modified a little to suit the method of working, *viz.*:

$$r = \sqrt[n-1]{\frac{l}{a}}$$

in which

r = common ratio,
l = last term,
a = first term,
n = number of terms (not means).

For the benefit of the beginner, the following graphical proof may be followed with profit. Examine the following series in geometrical progression: 2, 4, 8, 16, 32. In this progression the common ratio obviously is $4/2 = 2$, 32 is the fifth term (l), and 2 the first term (a). If these terms only are known, the common ratio is found by extracting the fourth root of $32 \div 2$ which equals 2. The root, it will be noted, (4) is the number of terms $n - l$. In our suppositious case

$l = 270$
$a = 6.5$
$n - l = 15$

r therefore is $\sqrt[15]{\frac{270}{6.5}}$

thus: $\log \sqrt[15]{\frac{270}{6.5}} = \frac{\log 270 - \log 6.5}{15} = \frac{2.4314 - 0.8129}{15} = 0.1079$

$= \log r$. Continued addition of $\log r$ (or 0.1079) to $\log 6.5$ (or 0.8129) gives the log of subsequent terms in the speed progression.

Speed.*	Log.	Number.	Speed.	Log.	Number.
1	.8129	6.5		1.5682	
	.1079			.1079	
2	.9208	8.333	9	1.6761	47.43
	.1079			.1079	
3	1.0287	10.69	10	1.7840	60.81
	.1079			.1079	
4	1.1366	13.70	11	1.8919	77.96
	.1079			.1079	
5	1.2445	17.56	12	1.9998	99.98
	.1079			.1079	
6	1.3524	22.51	13	2.1077	121.1
	.1079			.1079	
7	1.4603	28.86	14	2.2156	164.3
	.1079			.1079	
8	1.5682	37.00	15	2.3235	210.6
				.1079	
			16	2.4314	270.1

It will be noted that although four figure logarithms have been used, the error after 15 successive additions is practically negligible. The original number, obtained at the fifteenth step, is a certain check upon the accuracy of the calculation.

When the numbers have been obtained, they are set out in tabular form (useless decimal places being omitted) to suit the particular gear system. For example:

SPINDLE SPEEDS.

	Hand Wheel at			
Levers at	A	B	C	D
1 and 3.....	6.5	8.3	10.7	13.7
1 and 4.....	17.6	22.5	29	37
2 and 3.....	47	61	78	100
2 and 4.....	128	164	211	270

These figures will no doubt require some modification after calculation of the gearing to the nearest tooth, but care in arrangement of center distances of gears always gives an approximation within about 2 per cent.

* * *

MALLEABLE VS. STEEL HAMMERS.

In the discussion of the paper by Mr. Raffe Emerson, presented before the New York Railroad Club last fall, the assertion was made that it is nonsensical to supply enginemen with good cast steel hammers. It appears that the New York Central experimented some years ago in this direction to save expenses. First, a hammer made of a steel casting was used with satisfaction, and finally one was made still cheaper by using ordinary malleable iron.

We do not know what the feelings of the average engineman are when required to use a malleable hammer, but we think that if he has had the mechanical training proper for the position that he would regard it as an insult. In the first place a malleable hammer is likely to be a dangerous tool; chips are liable to fly from the face when struck against a steel surface, which may injure the sight, and in the second place the cheapness and crudity of such a tool would tend to destroy the pride an engineman should have in keeping up his tool equipment. The importance of this depends largely on the personal equation, but the point is that there are wasteful economies, and we believe that the malleable hammer is a horrible example. The amount that a railroad corporation can save in one year by using such hammers in place of good steel hammers is so inconsequential that it can hardly afford to offend the sensibilities of its employes by such substitution.

* Address: 40 Greshan St., Coventry, Eng.

SIZES OF WORKING DRAWINGS.*

WILLIAM L. BREATH.†

William L. Breath.‡

Manufacturers do not have any universal standard of sizes for working drawings. From time to time there have been recommendations made by various societies regarding standard sizes, but these recommendations have had little effect in bringing about any generally accepted standard in drafting-room practice. Many firms use large and unwieldy drawings, which are as difficult for the draftsmen to work on, as they are cumbersome to handle by those who are to use them. Of course, most drafting-rooms have their own standard sizes for the sheets. There is usually a small sheet for sketches and details and then larger sizes which are multiples of the detail size. These larger sizes are used for the assembly drawings and for detailing large pieces. It is, however, difficult to take care of all these various sizes of drawings, a difficulty which can be avoided by having only one size sheet of a convenient size for both the draftsmen and the shop.

The size of the sheet to be adopted should be chosen first of all with regard to economy in cutting the sheets from commercial sizes of paper and tracing cloth. Tracing cloth comes in rolls 30, 36, 42, or 48 inches wide, and there is thus a wide range to choose from. The standard sheet used

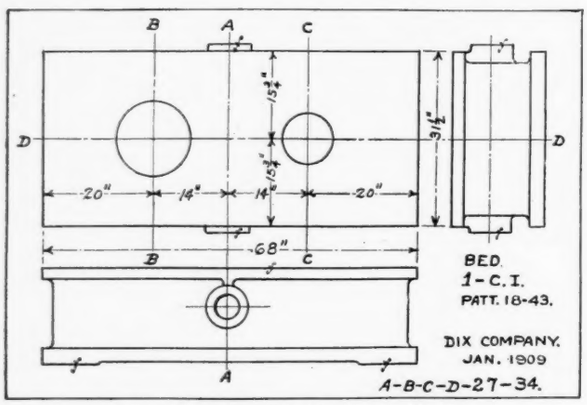


Fig. 1. Master Drawing of Simple Machine Bed.

by the U. S. Navy department, and, the writer believes, also by other departments of the government, is 21 by 27 inches.

All manufacturers working on orders for the Navy must send tracings of their work on this size sheet, and some manufacturers, therefore, have adopted this size as their own standard. It can be cut without waste from a roll 42 inches wide, but it is, however, too large to be convenient for the draftsman, as it makes his work much more tiresome than a small sheet where all corners can be readily reached from one position. Besides, this sheet gives more room than is necessary for detailing one piece of ordinary size, and therefore, as many as twenty pieces are often detailed on one sheet. This is an inconvenient system, as it often happens in the shop that two or more men must refer to different details on the same drawing, and often the blue-print will be cut in pieces so that each man gets the part on which he is working. This is a common-sense way of avoiding the inconvenience of having two men working on the same blue-print, and also is a hint to the drafting-room to have but one detail on each sheet. A convenient size sheet could be obtained by cutting the size mentioned in two, making a size 13½ by 21 inches. Even a somewhat smaller sheet, say 18 by 12 inches would be better.

To use a small size sheet for all assembly drawings and for detailing of large pieces, requires a method somewhat different from those ordinarily in use in drafting-rooms, but it does not add to the complication of the work of the drafting-room. Fig. 1 shows a 13½ by 21-inch sheet, and on it is drawn a bed of simple design. The bed is drawn only in outline, and shows a plan, elevation and end view. The main center lines are also drawn, as well as the main faces. The drawing is numbered according to the regular system of the drafting-room. The center lines are lettered *A-A*, *B-B*,

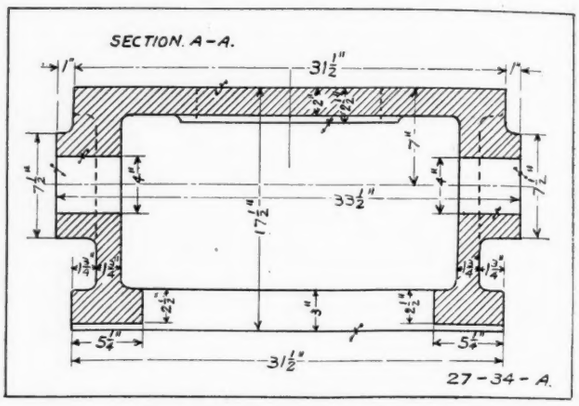


Fig. 2. Detail Section of Bed in Fig. 1.

C-C, *D-D*; *A* refers to a second sheet of the same size on which is drawn to a larger scale the section *A-A* of the bed. On this sheet are put all dimensions, notes and instructions necessary. In the same way sheets *B*, *C* and *D* are drawn until the bed is fully detailed. The master sheet, Fig. 1, has in the title corner the letters *A*, *B*, *C* and *D*, showing at a glance how many sheets there are in the complete set. The next piece in the construction would be detailed in a similar way, the master sheet taking the number 27-35, and having as many supplementary sheets, *A*, *B* and *C* as necessary.

In case there is room on one sheet for more than one detailed section, these sections will be noted on the master drawing by the letters *A-A*, *A-B*, *A-C*, etc., the letter *A* being used for each section on sheet *A*. If the piece to be detailed is too large or complicated to have the three views clearly outlined on the master sheet, then each view will be made on a separate sheet, and the plan view will be considered the master drawing; the other master drawings have the same serial number, with a number added, as for instance, 27-34-1,

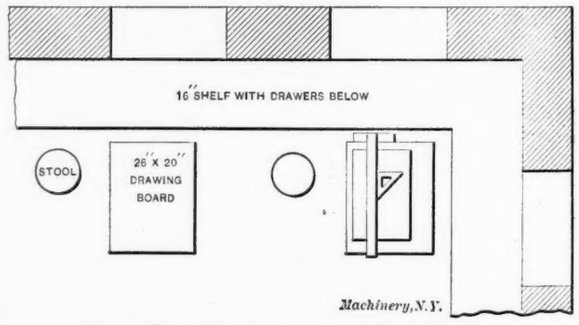


Fig. 3. Convenient Arrangement of Drafting-room.

and 27-34-2. In this way every part of the machine will be fully shown, as well in its relation to the other parts as in detail. In fact, the main purpose of the master drawing is to show the relation of the different parts of the machine to each other. When the master and detail drawings of a machine are fully completed, they can be bound together by any suitable loose-leaf method, and if desired for reference, an index of the pieces can be made on a standard sheet, and bound with them.

Fig. 3 shows a convenient arrangement of a part of a drafting-room, where the small sheet system has been adopted. The designing draftsman's board is not shown. He, of course,

* For additional information on standard drafting-room methods, and kindred subjects, see MACHINERY, February, 1908: Standard Drawing-Room Methods, and also the articles there referred to.

† Address: 258 Lefferts Ave., Brooklyn, N. Y.

‡ William L. Breath was born 1859. He has been a draftsman, working for the Atlas Engine Works, Indianapolis, Ind.; American Tobacco Co., New York; Standard Motor Construction Co., Jersey City, N. J.; Power and Mining Machinery Co., Cudahy, Wis.; Pneumatic Torpedo Construction Co. His specialty is gas power and fine machinery.

must have a board as large as is convenient for the actual designing work. Running around the room, and under the window sills, is a shelf 16 inches wide, with drawers under large enough for the standard size drawing. The draftsman's tools and books can also be kept in drawers under the shelves. Being at the left hand of the draftsman, the shelf is a convenient place for reference drawings, books, etc. The working table need be but very small, as a board 20 by 26 inches will be amply large enough. The board should be mounted on a cast stand, and pivoted so that it can revolve, as a swinging board is much easier to work on.

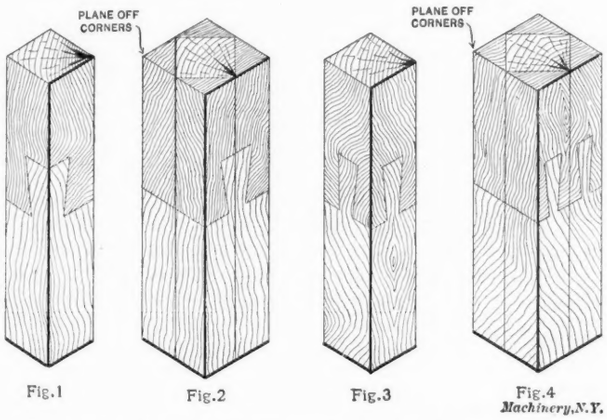
The system of small sheets outlined can also be used for drawings of buildings, power plants, and structual designs. One drawing gives a general outline of the construction, and then the various detail drawings show successively the details of different portions of the construction.

* * *

SOME OLD-TIME PUZZLES IN WOOD.

Among the many changes incident to the introduction of machinery and the consequent passing of the old-time handworker, is one that, while of no economic importance, is interesting as marking a difference between the old leisurely habits of the shops of a generation or two ago, and those of to-day.

In the old days the greenhorn apprentice was subjected to a variety of tests which taxed his temper, and also his ingenuity and gumption, and a number of these, all of which are interesting and ingenious, were recently described and illustrated in *Wood Craft*, and are herewith reproduced.

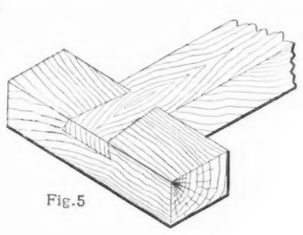


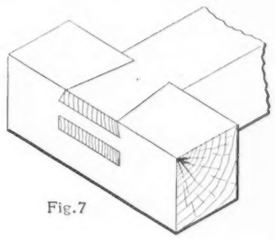
Figs. 1 and 2. Finished Dovetail Joint and the Way in which the Joint is made. Figs. 3 and 4. Finished Joint with Two Dovetails, and the Method of making the Joint, which is the same as for Fig. 1.

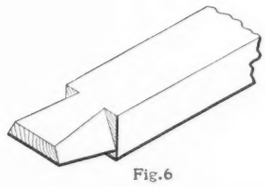
The tests of the learner's skill and ingenuity were of a useful nature, and generally in the direction of some little problems in tool-work lying outside the everyday tasks of the shops. Very often these took the form of a puzzle joint, one of the first to be shown to the budding craftsman being the mystifying dovetailed splice shown in Fig. 1. When formed of two different kinds of wood having a sharp contrast in their colors, this joint presents a very puzzling appearance, especially if glued up so that it may not be taken apart. If left loose, however, the mystery vanishes, for it is then readily seen that the joint is a simple dovetail running diagonally through the pieces. The fitting of such a joint would be a difficult matter if the dovetail pin and socket were cut diagonally, as shown in the finished joint, but is an exceedingly simple thing if done as illustrated in Fig. 2, across the square way of the pieces. The joint is fitted thus, and after being put together, the corners of the square block are planed down to the center lines as indicated by the lines on top of the piece, thus giving the completed joint the appearance so puzzling in Fig. 1.

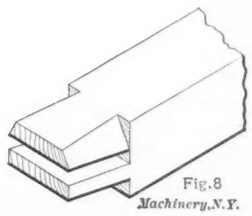
Fig. 3, which shows a complete dovetail on each face of the finished joint, is a more difficult-looking puzzle, though made in a manner precisely similar to the joint illustrated in Fig. 1. This joint is made by fitting a pair of dovetails side by side as in Fig. 4, the corners being afterwards planed off as in the case of the first joint. Care must be taken to lay out the dovetails evenly on each side of the central line of the blocks. Of course, it should scarcely be necessary to add that a good fit throughout is required, or yawning joints will give the trick away when the piece is planed off at angles of 45 degrees to the original faces of the block.

Another dovetail puzzle is shown in Fig. 5, which is a T-joint apparently put together in an impossible way. Fig. 6 reveals the secret of its construction, which needs no further description. Sometimes this T-joint has a tenon in addition to the dovetail, and appears as in Fig. 7, the details being made plain by Fig. 8.









Figs. 5 and 6. A Deceptive Dovetail and the Way in which it is made.

Figs. 7 and 8. A Joint Similar to the One shown in Fig. 5, with the Addition of a Tenon.

Some years ago an enterprising firm of soap manufacturers whose name is a household word on several continents, gave away as an advertisement some millions of another wood puzzle that was a favorite among the old hand-workers in days gone by. A sketch of it is shown in Fig. 9, and it will be seen to consist of a hammer-headed key-piece inserted through another piece, both being absolutely solid, and without joints. The apparently impossible task of passing the large hammer-head through the narrow mortise, is accomplished by selecting a piece of soft white pine for the key, and thoroughly boiling or steaming one end of it until it is quite soft. It is then squeezed in the jaws of a powerful vise, and slipped quickly through the mortise, when it immediately begins to swell and with a little soaking will resume its former size and shape.

The concluding example is notable because of the fact that it has found its way from the workshop to the pages of more than one treatise on descriptive geometry. The puzzle, as usually stated, says that three holes are to be cut in a piece of wood—one round, one square, and one triangular, and another piece of wood is to be cut so that it will fit each hole. A piece about ¼ inch in thickness is selected, and the holes, *a*, *b*, *c*, cut in it as in Fig. 10. The circle *a* is equal in diameter to the side of the square *b*, which is equal to the base and altitude of the triangle *c*. A cylindrical block is then turned or planed to fit the circular hole. By cutting this cylinder *a*, Fig. 11, to the same length as its diameter, it will just fill the square hole *b*, and by paring off on opposite sides until it is triangular in section in one of its dimensions as at *c*, the third condition is fullfilled, and a piece is formed which will fit each hole. Fig. 11 shows the required block for the purpose, *a* being the cylinder to fit the circle at *a*, Fig. 10, *b* the square plug, and *c* the triangular piece.

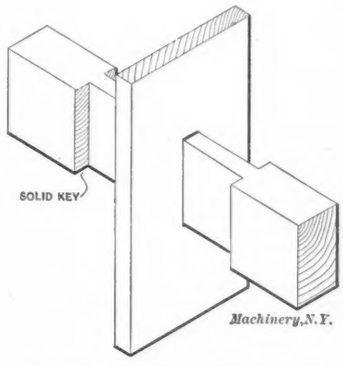


Fig. 9. A Combination which seems Impossible.

THE ENGINEER AND THE PEOPLE.*

In a paper read before the American Society of Mechanical Engineers, entitled "The Engineer and the People," the author, Mr. M. L. Cooke, proposed a plan for obtaining a larger measure of cooperation between the society and the general public, which should receive the endorsement and aid of every member. The present-day conditions which seem to demand a broadening of the lines of professional activity, were pointed out, and specific recommendations made which, if adopted, would doubtless greatly extend the engineers' field of usefulness and make him a "special conservator of the public's interest in matters involving engineering." Said the author, in speaking of the object of the society: "The distinguished authors of the constitution of the A. S. M. E. stated its object in a way to permit of an almost indefinite expansion of function. 'The object of the society is to promote the arts and sciences connected with engineering and mechanical construction.' "That the constitution, however, imposes no duties on the membership, except those of a purely professional interest, witness as follows": 'The proper means for this

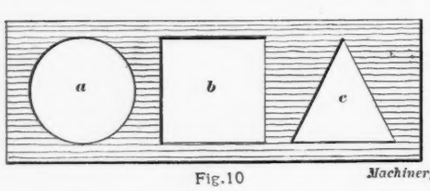
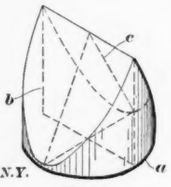


Fig.10



Machinery,N.Y.
Fig.11

Figs. 10 and 11. Piece with Round, Square, and Triangular Holes, and Plug which fits them all.

purpose shall be the holding of meetings for the reading and discussion of professional papers and for social intercourse; the publication and distribution of its papers and discussions; and the maintenance of an engineering library.' "The library may be made in the future to minister to the requirements of the laymen interested in technical matters, but up to this time its direct influence on the interests of the people is almost negligible. A radical and in every way salutary change can be brought about in the society's relations with the general public by the appointment of a committee to be known as the "Committee on Relations with the Public." The work of this committee would, of course, have to be done within carefully thought out and definitely prescribed limits. It would doubtless seek to establish such relations with the lay press as would make its device and help sought when engineering matters are up for public discussion. It would also doubtless seek to give publicity to the fact that the society stands ready to offer disinterested advice through its council to government officials—municipal, state or national. In most cases, of course, this assistance would not be so much to answer engineering questions as to counsel with government officials to the proper procedure to obtain answers. This committee might also provide for a course of lectures for the general public, to be given under its supervision in the Engineering Societies' Building in New York, or under the auspices of local engineering societies at other places. Another important part of the work of such a committee would be to arrange that a fair proportion of professional papers presented at the various meetings of the society should be of direct use and value to the public as well as to the mechanical engineer. The cumulative effect of these, and of such other lines of work as would soon suggest themselves, would be very marked.

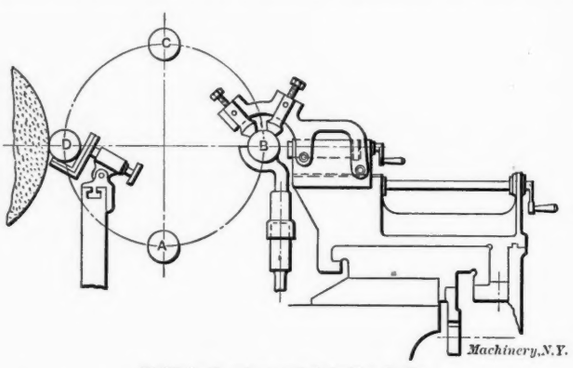
"The matter of the conservation of our natural resources will afford, probably for years, a practically limitless field for investigation and earnest discussion. The questions involved are so momentous as to warrant the engineer in seeking ways of cooperation with the national and state governments for their solution. No better way could be found for our society to assist in this work than to provide in its meetings and publications a forum for the discussion of those phases of the general problem in which the mechanical engineer is especially qualified to speak. The records of engineering in the early days of the last century show that engineers had not then learned how to cooperate with one another. Up to a comparatively recent date the professional knowledge of the engineer was his own property, and he felt that in imparting any of this knowledge to another engineer that he was doing himself a decided injury. The large number of engineering societies, with the fundamental object of the free exchange of engineering data between their members, shows how thoroughly engineers have learned that the general policy of giving freely of their knowledge to their fellow practitioners, increases rather than diminishes their effectiveness and, in proportion, their earning power. In proposing the appointment of this new standing committee, the writer suggests only the extension of this cooperation to include the public. There is good reason to believe that engineers have as much to gain from cooperation with the public as they have undoubtedly gained from the cooperation with one another. It is no longer possible for any profession or craft to corner information and hold it for its own use. Broadly speaking, those who seek information in any field can obtain it, or at least enough to answer their immediate purposes, and therein lies a danger. This danger would not in itself constitute a sufficient reason for the engineer to take the public into his confidence, for, after all, it is public opinion and not the dictum of the engineering fraternity which finally decides the large questions of engineering practice. How much better it would be to join forces with the people to work out with them their problems and to build up in the lay mind such a confidence in our devotion to the people's cause that they will be willing to let us lead in matters where our training especially qualifies us to lead. Only by educating the public to understand and appreciate the work of the engineer, can the public be made to demand the best that can be devised and executed by trained and skillful men. This will have a twofold beneficial effect on the profession, in that it will make more work for the engineer, and will give the public that general acquaintance with engineering matters which will make it suspicious of short cuts.

* Extracts from a paper by Mr. Morris Llewellyn Cooke, read before the December, 1908, meeting of the American Society of Mechanical Engineers.

* * *

MULTIPLE SPINDLE SHAFTING LATHE.

In the December 25th issue of *Engineering* (London) is described a multiple turning and grinding lathe for finishing shafting, built by Messrs. MacDonald, Swinburne & Co., Barrhead near Glasgow. The peculiarity of the machine, as shown by the accompanying diagram, is that it holds four shafts simultaneously. One of these, at *A*, is in position for insertion or removal. The indexing of the revolving head- and tail-stocks next brings the shaft to position *B*, where it is



Multiple Turning and Grinding Lathe.

turned. The third position, *C*, is an idle position. At *D* it is being ground by a traversing emery wheel. When it arrives at *A* again, it is removed. The shafting enters the end of the bed of the machine, below the tail-stock, being carried in by a rolled conveyor; a mechanical lifting arrangement then raises it to position *A*, where it is clamped in place. The same rolled conveyor removes the work after it has been completed. Suitable arrangements for steady rests for both turning and grinding operations are provided so that these operations may be simultaneously performed in accordance with the best practice, both as to speed and accuracy. The machine will take solid or hollow shafting up to 4 inches in diameter and 22 feet long, and will finish within a limit of 0.00025 inch.

DESIGN AND CONSTRUCTION OF ELECTRIC OVERHEAD CRANES—3.

GEARING.

R. B. BROWN.

The gearing may be regarded as one of the most important details of crane design, since on its merits rest the efficiency and safety of the crane. A few years ago all lifting machinery was worked by wheels having cast teeth, but with the introduction of electric driving, and higher speeds, machine-cut gearing became necessary. The adoption of cut gears has grown to such an extent that a large quantity of cranes are now supplied with machine-cut gears throughout. In deciding how many of the gears of a crane ought to have the teeth machine cut, some consideration should be given to the work the crane is likely to have to do. If the speeds are high, or the crane is going to be in continual use, it will pay to have as many of the gears machine cut as possible, because the subsequent saving in electric current will soon pay for the extra first cost.

For constantly-working high-speed cranes up to seven-tons load, it will be found the most satisfactory to have machine-cut gears throughout, including the barrel wheel and pinion. For all sizes above seven tons it is not advisable to machine cut the barrel gear and pinion even for the best class of work, partly owing to the fact that it is desirable to shroud the pinion of this pair of wheels; and as the speed is low, the loss in power due to friction is not worth consideration. For cheap cranes, and those required for intermittent working, as in engine rooms for instance, it is only necessary to have the first reduction for each motion machine cut.

Raw hide or buffoline motor pinions have been found suitable, and are to be recommended for the first reduction for cranes up to twenty-tons load. The gear with which this pinion meshes should be of cast iron, since it has been found that the strength of raw hide and cast iron teeth are about the same. The principal advantages of raw hide pinions are that they run almost noiselessly and do not require any lubricant. A gear case need not be provided for this reduction unless the crane is working in a very damp location. For cranes above twenty tons the motor pinion ought to be of machine steel, running with a cast iron or steel gear, preferably in an oil bath, the latter taking the form of a cast iron gear case.

It is generally found advisable to make small machine-cut pinions of machine steel, the blanks usually being cut from ordinary rolled bar, or forged to size. When this is done, the pinion teeth are considerably stronger than those of the gear, if this is made of cast iron, and about equal in strength to those of a cast steel gear.

For cranes up to twenty tons the barrel gear and pinion can be of cast iron; above this size cast steel is preferable, and in all cases above seven tons the pinion should be full shrouded, thereby making the teeth about equal in strength to those of the gear. For cranes above twenty tons it is considered good practice to make all pinions of steel, whether they are machine cut or not; while for cranes which are very severely handled and constantly on full load, as for instance steel works and forge cranes, the purchaser will probably find it most satisfactory in the end to have steel gears throughout for all motions. It will be found satisfactory for ordinary work to have cast iron gears for cranes up to twenty tons, and above this size and up to forty tons to have all pinions and the barrel gear of steel and the remainder cast iron. Cranes above forty tons should preferably have steel gears throughout.

In order to keep down the size of the crab in every way, the pinions should be kept as small as possible consistent with smooth running, but at the same time no pinion should ever have less than twelve teeth, since below this size pinions run badly and are very weak, and cutters for a smaller number of teeth are not usually on hand.

Strength of Teeth in the Gears.

The most important question concerning the gearing lies in the strength of the teeth, and a great variation is found in practice in the stress to which the material is subjected. Upon examining the practice of various firms, one finds that while some stress the cast iron barrel gear teeth to one ton per square inch, and the steel gear teeth to three tons per square inch, others work to as much as three and six tons per square inch, respectively. Now the average ultimate strength of cast iron and cast steel subject to bending as in a tooth is eighteen and thirty tons, respectively, but it is possible for either of these values, and particularly that of cast iron, to be considerably reduced by a lack of homogeneity in the metal, which may never be detected even if it is not wholly internal. With due consideration to the above fact, one is justified in allowing a factor of safety of 8 for cast iron, and 6 for steel for slow running.

Several convenient tables have been compiled for rapidly arriving at the pitch and width of the teeth, but before referring to these it is advisable to calculate the strength. The teeth of gearing used for crane work are of the involute pattern with radial flanks which gives a fairly short tooth with a broad root, and are consequently of the greatest strength.

Prof. Unwin states that the load which falls upon one tooth lies between one-half the full load and the total load, and is generally taken at two-thirds the full load, but if the pinion is small, it is common practice to consider the full load as taken by one tooth. When the pinion is of steel and the gear of cast iron, or the pinion is full shrouded, the gear teeth can be considered weaker or equal to those of the pinion, and the strength calculated accordingly to suit the shape of the teeth in the gear. Prof. Unwin also states that the agreed percentage of the full load will act, at one particular period, on the full length of the tooth, and this should be allowed for.

In calculating the strength of a tooth, it must be regarded as a cantilever, and made strong enough to resist the consequent bending moment. As an example, find the stress in the teeth of a steel barrel gear having 108 teeth of 1¾ inch circular pitch by 5 inches wide, and keyed onto the barrel of a 30-ton crane; diameter of barrel, two feet, fifteen tons load on the barrel. The diameter of the gear is approximately 5 feet.

$$\text{Load on tooth} = \frac{15 \times 2}{5} = 6 \text{ tons.}$$

$$\text{Maximum load at full length of tooth} = \frac{2}{3} \times 6 = 4 \text{ tons.}$$

Full length of tooth = 1.09 inch.

Bending moment = $4 \times 1.09 = 4.36$ inch-tons.

Modulus of tooth at root = 1.03.

$$\text{Stress} = \frac{4.36}{1.03} = 4.2 \text{ tons per square inch,}$$

which is a suitable working stress for slow running cast steel gears.

Some makers shroud the barrel gear and pinion to the pitch line, but if the strength has been calculated as shown above, this form of shrouding does not add to the strength required to resist bending, because if the bending moment and modulus are taken at the pitch line, they will be in similar proportion to those found at the root. The principal value of half shrouding is in minimizing the tendency the teeth have to break across the corner, especially with cast gears where the teeth may not bear evenly together, or may not be parallel to each other.

TABLE VI. ALLOWABLE FIBER STRESS IN GEAR TEETH.

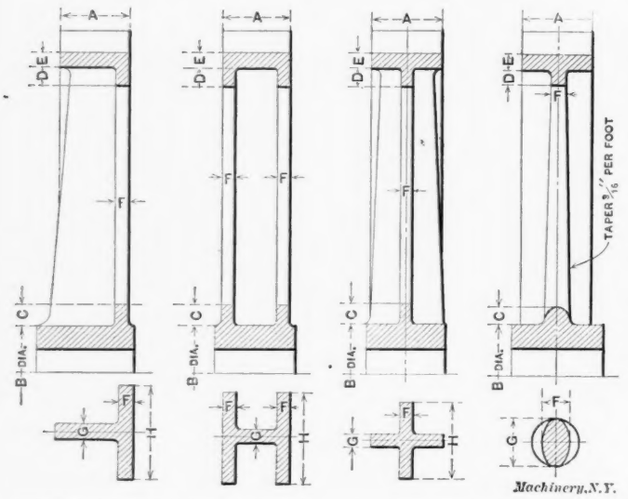
Material.	Speed at Pitch Line in Feet per Minute.							
	100	200	300	600	900	1200	1800	2400
Cast iron.....	4800	4200	3800	3200	2400	1920	1600	1360
Cast steel	12000	10500	9600	8000	6000	4800	4000	3400
Gun-metal	7200	6300	5760	4800	3600	2880	2400	2040
Machine steel	19200	14410	11200	9600	7200	5760	4800	4080

For heavy cranes, say 30 tons and upwards, double helical gears for the barrel gear and pinion have been used with advantage, since they insure a freedom from shock. That helical gearing is much stronger than spur gearing there is no

doubt, but there are many opinions as to their relative values. Since the points of contact on a well made tooth of this type at any moment are distributed over the whole of the working face, from root to point, the average leverage of the whole load is only half that of ordinary spur gears. Then, again, the developed width of these teeth is more for a certain width of wheel, and in calculating the strength, this can be taken into account. It is not safe, however, to allow in full for all these advantages over ordinary spur gears, owing to the fact that in practice it has been found difficult to make the apeces of each pair of teeth run in the same plane, and hence the load may be thrown on one side of the gear only. This difficulty may be avoided to some extent by allowing a little lateral play on the pinion shaft whereby the pinion will adjust its position to suit the gear, and consequently equalize the stresses somewhat. In the absence of any reliable

TABLE VII. DIMENSIONS OF GEAR RIMS AND ARMS.

P = circular pitch; b = bore.



Form of Arm.	A	B	C	D	E	F	G	H (at rim)
T section.....	$3P$	$1\frac{7}{8}b$	$\frac{5}{16}P$	$\frac{9}{16}P$	$\frac{1}{2}P$	$\frac{1}{2}P$	$\frac{1}{8}P$	$2\frac{1}{4}P$
I-section.....	$3P$	$1\frac{7}{8}b$	$\frac{5}{16}P$	$\frac{9}{16}P$	$\frac{1}{2}P$	$\frac{1}{2}P$	$\frac{1}{8}P$	$2\frac{1}{4}P$
+-section.....	$3P$	$1\frac{7}{8}b$	$\frac{5}{16}P$	$\frac{9}{16}P$	$\frac{1}{2}P$	$\frac{1}{2}P$	$\frac{1}{8}P$	$2\frac{1}{4}P$
Oval section.....	$3P$	$1\frac{7}{8}b$	$\frac{5}{16}P$	$\frac{9}{16}P$	$\frac{1}{2}P$	$\frac{1}{2}G$	$2\frac{1}{8}P$	.....

data on the strength of these gears, they are seldom considered as more than one and one-half times as strong as ordinary spur gears.

In calculating the pressure on the teeth of any pair of gears, it is, with the exception of the barrel gear and pinion, more correct to allow for the load due to the maximum torque of the motor, than to take the reaction from the load, since this latter does not allow for the resistance due to the friction of the intermediate gearing.

The stresses to which gear teeth may be subjected depend principally on the pitch line speed, and the nature of the work to be done; *i. e.*, whether running under a steady load in one direction, or subject to varying loads and quick reversal, as in cranes.

The most convenient way for calculating the strength of gear teeth is by the Lewis formula. This formula is:

$$W = SPFY,$$

in which

W = force at pitch line in pounds,

P = circular pitch,

S = allowable fiber stress for the material used, in pounds per square inch (see Table VI),

F = width of face of gear,

Y = the factor known as the Lewis outline factor which varies with the number of teeth and the form of gear tooth.*

Applying this formula to the previous example, we have: $S = 12{,}000$ (from Table VI); $P = 1.75$; $F = 5$; and $Y = 0.118$ for 108 teeth and 15 degree involute gearing. Consequently,

$$W = 12{,}000 \times 1.75 \times 5 \times 0.118 = 12{,}390 \text{ pounds.}$$

Dimensions of Arms, Rim and Hub.

The proportions of the arms, rim and boss of a gear are often determined by practical considerations of casting, but at the same time the strength of the arms may be calculated and it is well to do this for large wheels transmitting heavy loads. There are several different kinds of sections of arms in use. The I-section is probably the most extensively used for machine molded gears in England, but it is not as commonly used in the United States; it is very strong but it is the most expensive, since the space between the arms must be cored. The T-section and +-section are often used, but are not as strong as the I-section. Oval and rectangular sections are coming more into use, and possess the advantages of strength, cheapness in patterns, and simplicity in molding—an advantage which, in turn, gives good castings.

To calculate the strength of the arms it is necessary to find the bending moment at the root; it is generally agreed that each arm takes its share of the peripheral load, therefore, the bending moment in each arm equals the load at the pitch line in tons multiplied by the distance from the pitch line to the root of the arm in inches, and divided by the number of arms. This quantity divided by a maximum of 2 tons for cast iron and 4 tons for cast steel gives the modulus required by each arm at the root, which can be found from the usual formulas for each section. For small gears it is hardly necessary to make this calculation, but proportion each part of the arms, rim, or boss to some function of the pitch. There are several tables of these proportions used in practice, and Table VII may be taken to represent a fair average.

The number of arms generally adopted in crane practice is:

Four for gears up to 3 feet diameter.

Six for gears from 3 feet to 6 feet diameter.

Eight for gears above 6 feet diameter.

Gears below one foot diameter are generally made with a solid plate web, possibly relieved with some holes. The thickness of this web should be about one-half the pitch, and the proportion of rim and boss should remain practically the same as for the armed wheels.

* * *

Several months ago we received a letter from an educator stating that a man was wanted to take charge of the school work of his institution, in machine design, and that the salary would be from $1,400 to $1,600. A man was required who was competent as a machine designer, being one who had had charge as chief draftsman, or in similar capacity, of all the designing for some concern manufacturing engines, pumps, machine tools, etc. In short, this man must be one who is able to design good-looking machines by the instinctive process as well as by the cut-and-dried rules of design.

It is hardly necessary to say that a first-class machine designer who not only has the qualifications gained by long experience, but also the analytical mind, the clearness of expression and magnetic quality that would fit him for a teacher, probably would be difficult to secure at double the salary offered. The low salaries offered by many leading engineering schools for important positions tend to fill the instructor ranks with men of only average ability, whereas such men should, in our opinion, be superior in education and mental force. It is little wonder that students graduating from some of our famous institutions are poorly fitted for engineering work until they have passed through a trying-out process. They have not felt the mental stimulus of a master mind.

* * *

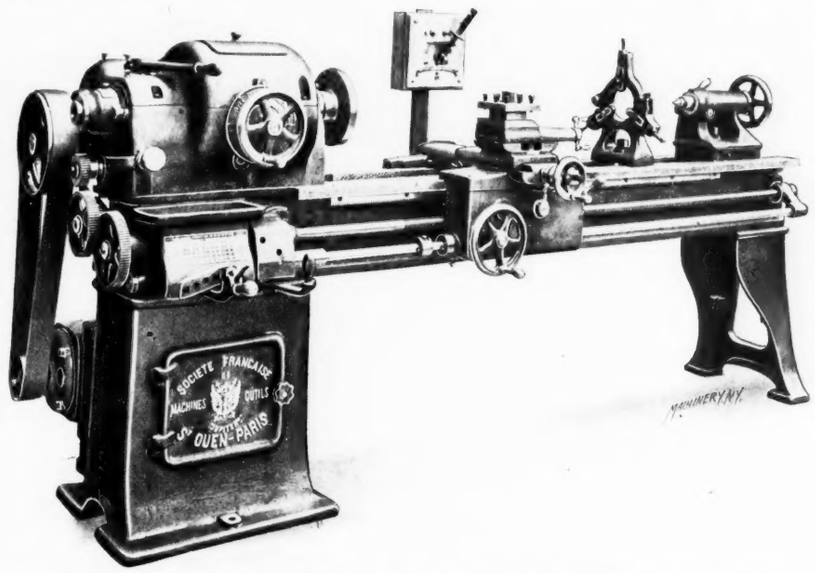
Some experiments which will prove valuable in aeronautics have been carried out by Professor Albert Frank of the Hanover Technological Institute in Germany. The report, as given in the *Zeitschrift des Vereines deutscher Ingenieure* states that 236 square feet of side surface develop no more resistance to the air than does one square foot of front surface placed perpendicular to the direction of motion. This indicates that comparatively small propeller surfaces are required as compared with the surfaces of the planes themselves in an aeroplane, to force the machine through the air.

* A table of the outline factors used in the Lewis formula may be found in Kent's "Mechanical Engineers' Pocket-book," page 901, and also in MACHINERY'S Reference Series, No. 15, Spur Gearing, page 45, and in MACHINERY'S Data Sheet No. 22, July, 1903.

SOCIETE FRANCAISE DE MACHINES-OUTILS SINGLE-PULLEY-DRIVE LATHE.

As our readers know, a machine tool building concern has recently been organized in France for the manufacture of machine tools of the most advanced type, particularly those applicable to automobile work. It will be remembered that Mr. Kylin, in his letter in the July issue of MACHINERY, stated that they were building a geared head and a cone-head lathe, a turret lathe of the Potter & Johnston type, an automatic dowel pin machine and a spur gear planer designed by Monsieur Mardin, the manager; and that they intended to take up the making of planers and vertical boring and turning mills. We show herewith an illustration of the geared head lathe manufactured by this firm. It appears to be of original design, and presents a number of features of interest.

The first noticeable departure from American practice to strike the eye, is the use of rectangular ways in place of the V-sliding surfaces to which we are accustomed. The carriage, steady-rest and tail-center, are supported by the same flat surfaces, the carriage being guided by the outer edge of the ways, while the two heads are confined between the inner



Single-pulley Lathe with Motor Drive, manufactured by Societe Francaise De Machines-Outils.

edges. This is in accordance with approved European usage. The bed is of heavy and rigid section, mounted on a cabinet base at the head-stock end.

The head-stock is of the single pulley type, and is provided with an unusually convenient arrangement for changing the speeds. The hand-wheel at the front of the enclosed head-stock gives eight changes of speed in geometrical progression, with no other movement than turning it from one position to another, as indicated by the large dial attached to its hub. The back gear arrangement doubles this number of speeds. It is controlled by the lever seen projecting forward over the rear spindle bearing. This may be used for starting and stopping the machine as well as for changing the speed. The single pulley drive has all the well-known advantages of this arrangement in avoiding the necessity for a complicated counter-shaft, allowing flexibility in the placing of tools, and making the matter of driving the tool by an electric motor a very simple one. In the case shown, the motor is mounted at the rear of the cabinet base, and is belted to the driving pulley. An ingenious and convenient feature is the mounting of the starting box on a support at the rear of the carriage. On long beds this is more convenient than mounting it in a fixed position on the machine.

The spindle is of high carbon steel and ground to size. The boxes are of hard bronze with cylindrical bearings and conical exterior surfaces, and are adjusted to fit the spindle by being shifted axially in their conical seats in the head-stock. A ball thrust bearing running in oil takes the axial pressure on the spindle.

A geared feed is provided, through the quick change box shown. This provides for six changes. The gears connecting it with the head-stock stud provide four more combinations, which give 24 changes of feed in all. This number, of course, may be multiplied indefinitely by using special gears. A splined feed rod and a lead screw are provided as in approved modern practice, it not being necessary to use the lead screw for turning, as is the case on many European makes of lathes. The feed rod has an endwise movement which operates a disengaging clutch, providing an automatic stop for the carriage. This is operated by the striking of the carriage against the adjustable stop collar shown on the feed rod. The disengaging clutch, thus controlled, is operated by the handle shown just at the right of the quick change handle. This serves also to connect the feed screw, it being impossible to throw the feed rod and the lead screw into action at the same time. The apron has double walls, giving firm support to all the mechanism which it contains. It provides for cross and longitudinal feed and for thread cutting. It is impossible to engage either of these three movements until the other two are disengaged, thus obviating all possibility of accident on this score. The use of the positive geared feed permits also, through the positive power cross-feed, the cutting of spirals on face-plate work.

The tool-post is four-sided, and may be swung like a turret to any one of four positions, in either of which it is positively locked by a bolt. This is especially useful in repetition work, as it permits the continuous changing of tools, and bringing them back exactly to their former position. As is common in foreign lathes, the compound rest is regularly provided, and is usually used for plain straight turning; when set parallel with the ways of the lathe, as shown, the workmen employ it for the fine longitudinal adjustments of the tool. The tail-stock is cut away to allow this, as is common nowadays in American practice. The tail-stock is so arranged as to permit its being released from the bed for a new longitudinal adjustment without disturbing its crosswise adjustment.

The machine is provided with small and large face-plates (the latter being provided with holes instead of slots), the necessary gears and wrenches, a center rest, and follow rest. A reversing counter-shaft is provided for belt-driven machines, and an attachment plate for electric motors when the machine is to be electrically driven. A device for truing the centers is also furnished.

* * *

In the quarrying of granite, large laminations or sheets of granite are separated from the main rock by an interesting operation called the "lifting" process. A groove is cut to the required depth all around the section of stone to be separated from the main body of the rock. In the center of the area to be lifted a drill hole two or three inches in diameter is sunk six or eight feet in depth, according to the required thickness of the stone. At the bottom, the drill hole is enlarged into a pocket, by exploding a charge of dynamite. Then some powder is exploded in the pocket thus formed. This will start a horizontal crack or cleavage, and as new charges of powder, increasing in size, are exploded in the cavity, the drill hole being plugged at every blast to confine the gases and cause constant force to act upon the stone, the crack will extend say from 75 to 100 feet in all directions from the lift hole. A pipe connecting with air compressors is then cemented into the hole, and air, of a pressure from 70 to 80 pounds, is pumped until the crack or cleavage extends to the edge of the rock. Sheets of stone of large size can be thus lifted, thereby affording the quarrymen a plane to work to, so that the stone can be drilled and split to proper sizes for the purposes required.

CLEARANCE OF MILLING CUTTERS.*

HARRY A. S. HOWARTH.†

The object of this article is to show graphically the factors that determine the clearance which should be ground on milling cutters. This will be done by drawing the cutting curves for a given cutter working under an exaggerated feed per revolution. The discussion will cover the following points:

1. A cutting edge leaves behind it, in the work, a curved path which lies within the circumference of the cutter. The angle between this curve and the circumference determines the clearance required.

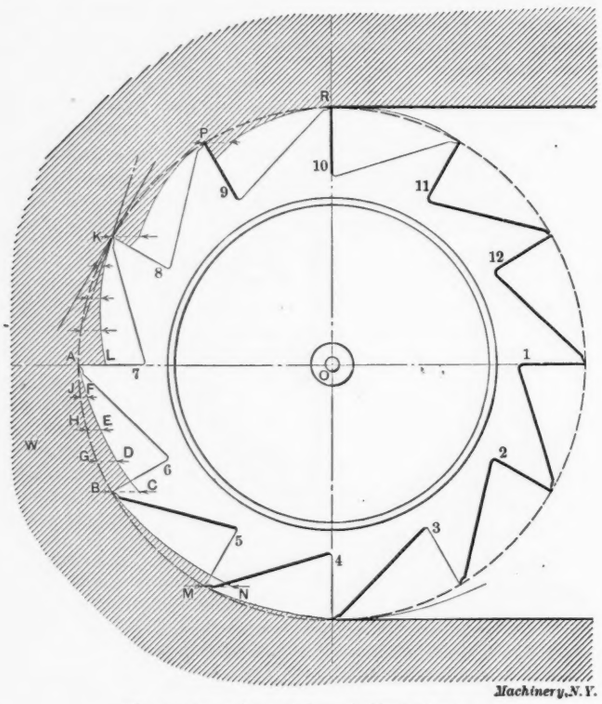


Fig. 1. Principle of Action of Milling Cutter.

2. This angle depends upon the feed, depth of cut, cutter diameter, and spindle speed.

3. Cutters with radial faces cut with a top rake equal to the clearance angle.

4. A coarse tooth cutter can mill a flat surface if it runs true.

5. Chattering is peculiarly dependent upon clearance, relation of tooth pitch to depth of cut, and combinations of pitch and spindle speed.

6. The pitch of cutter teeth depends upon the degree of finish wanted, depth of cut, amount of metal removed, and properties of the material being cut.

7. The diameter of a cutter should not be larger than that necessary to insure rigidity under the working conditions.

8. Repeated grinding necessitates an increase, each time, of the apparent clearance, it being gaged by the depth of the heel of the cutting edge below the cutter circumference. Excessive grinding necessitates slower feeds and speeds.

Clearance Angle.

In Fig. 1 is shown a cutter assumed to be 6½ inches in diameter. It has twelve teeth, and is represented cutting its way through a solid block of metal so that the teeth are cutting during one-half of a revolution of the spindle. The work W is fed against the cutter at the rate of four inches per revolution of the spindle, i. e., 1/3 inch per 1/12 revolution of the cutter.

Let us examine tooth No. 7. Its point A, while turning from B to A has cut the path $C\,D\,E\,F\,A$ in the work W. When A was at B, the point C on the work was also at B. To make this clear, imagine the cutter to revolve backward and the feed to be reversed. As A turns to J, which is one-quarter the distance to B on the circumference, the point F in the work recedes to J. The distance $J\,F$ is $1/4 \times 1/3 = 1/12$ inch. Similarly, if A moves to H, the point E recedes to H. The distance $E\,H$ is $1/2 \times 1/3 = 1/6$ inch. Following up this method, we have $D\,G = 1/4$ inch, and $C\,B = 1/3$ inch. These distances are measured parallel to the direction of the feed, and the curve $A\,C$ is part of a cycloid.

As the work feeds against the cutter each tooth thus leaves behind it a curved parth which lies within the circumference of the cutter.

At the point K in Fig. 1 draw a tangent to cutting curve $L\,K$. This represents the direction of motion of the cutting edge K with respect to the work at this instant. Draw also a tangent to the circumference of the cutter at K. This represents the direction of motion of the cutting edge K with respect to the spindle. The angle between these two tangents represents the minimum angle of clearance at K which will allow the work to advance toward the cutter at the rate of feed assumed, *i. e.*, 4 inches per revolution of the spindle.

Factors Determining the Clearance Angle.

It is evident from the cutting curves drawn that the angle between the two tangents will not be the same at M, B, A, K, P and R. It also appears that the angle is maximum at a point, above the center line $A\,O$, and in the neighborhood of K. It seems clear that tooth No. 8 requires more clearance to cut at K than tooth No. 6 requires to cut at B. Yet these teeth are symmetrically opposite with respect to the center line of the cut. This fact has a significance which will be noted later.

It is theoretically impossible to feed work at a given rate against a cutter unless the shapes of all the teeth back of the cutting edges conform to that cutting curve which makes, with the circumference of the cutter, the maximum angle corresponding to the given feed.

In order to find graphically the exact point which under the given conditions requires the greatest clearance, the single curve shown in Fig. 2 may be drawn. This represents the path that would be cut by a single tooth making a complete revolution while the work moves a distance equal to $Z\,R$ or $U\,V$. Suppose the center of the arbor is at V and the single tooth is at R. Consider the cutter as advancing toward the work. When V moves to X and the cutting edge moves to Q directly ahead of X, the cutter has made a quarter turn. If the feed is 4 inches per turn, the distance $V\,X = 1$ inch. As V advances from X to Y, R moves from Q to S directly above Y, and $X\,Y = 2$ inches. In this manner the tooth describes the path of the cycloid $R\,S\,Z$ while the spindle advances 4 inches or from V to U and makes one complete revolution.

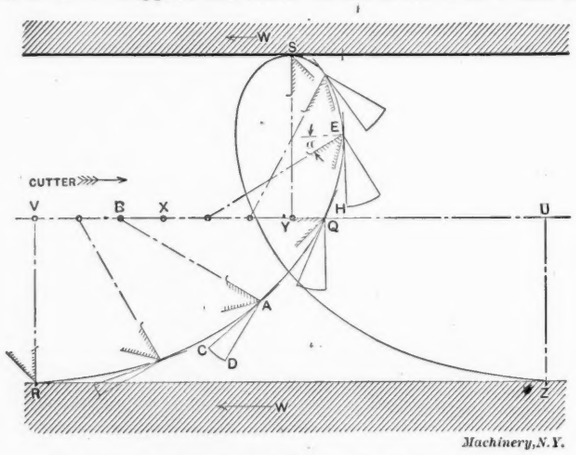


Fig. 2. Path of Milling Cutter Tooth, when Feed is less than Circumference of Cutter.

Assume the cutting edge to be at some point A. The corresponding position of the spindle is B. Construct the two tan-

* The following articles on milling cutters have previously appeared in MACHINERY: A Milling Cutter Working on a New Principle, March, 1904; The Shaping, Grinding and Hardening of Milling Cutters, December, 1904, engineering edition; Tool Making: Milling Machine Cutters, January and February, 1905; Milling Cutters, April, 1906; Cutters of Cold-rolled Steel, July, 1906; Milling Machine Output, October, 1907, engineering edition; Setting Angles for Milling Angular Cutters, November, 1908, enginering edition; New Type of Milling Cutter, December, 1908; Development of a High-Speed Milling Cutter with Inserted Blades, December, 1908, engineering edition; Efficiency Tests of Milling Machines and Milling Cutters, December, 1908, engineering edition.

† Address, P. O. Box 174, So. Bethlehem, Pa.

gents at A; $C\,A$ is tangent to the cycloid; $A\,D$ is perpendicular to the radius $A\,B$. Angle $C\,A\,D$ is the clearance angle required at A. A few similar constructions at points Q, E and S, etc., show by comparing the angles that the position of greatest required clearance for this case is at some point E.

The position of greatest clearance E varies with the ratio of the feed to the diameter of the cutter. If the diameter is kept constant and the feed reduced, point E will approach Q. It reaches Q when the feed is zero. Thus the limiting position of clearance E is at the center line $Q\,V$ when the cutting curve becomes a circle and U and V coincide. At this limit the clearance angle becomes zero.

When the feed per revolution is increased so as to equal the circumference of the cutter, the cutting curve becomes as shown in Fig. 3. Here the limiting position of greatest clearance is S_1 at the apex of the curve. At this point the clearance becomes 90 degrees.. This is shown by drawing the series of clearance angles as before mentioned.

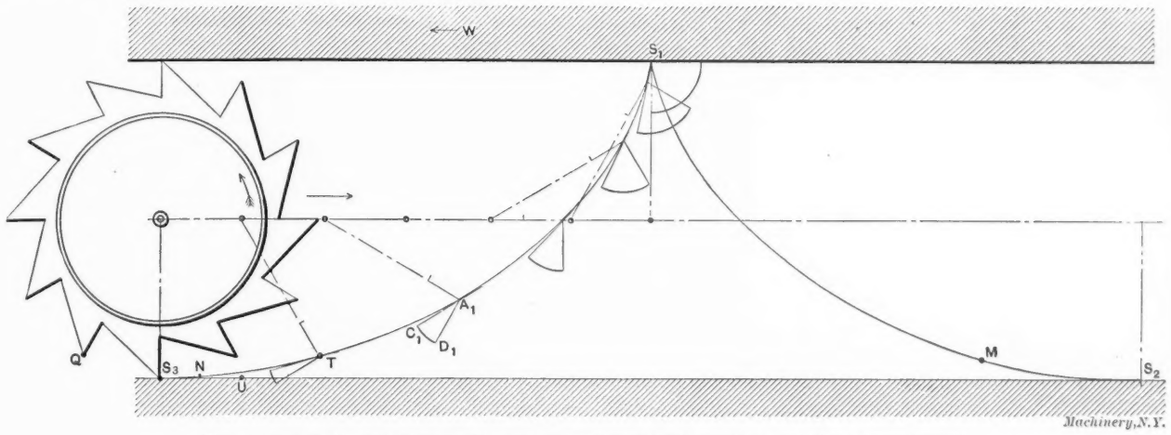


Fig. 3. Path of Milling Cutter Tooth, with an Imaginary Feed equal to the Cutter Circumference.

Of course, these two extremes are impossible cases practically, but under certain conditions they are approached, as when a cutter with no clearance whatever is put to work; and when a cutter is started in the wrong direction over a piece of work and draws the work under it at a speed equal to its circumferential speed.

The conclusions resulting from the previous discussion are as follows:

(a). The point of greatest clearance rises from Q to S (see Fig. 2) as the rate of feed is increased from zero to the cutter circumference per revolution of the cutter.

(b). The greater the ratio of the feed per revolution to the diameter of the cutter, the greater is the clearance required. This clearance does not depend on the number of teeth in the cutter.

(c). The cutting curves shown represent the minimum limit of the clearance which must be ground on cutters running under the conditions assumed. Practically more clearance must be used in order to avoid rubbing the heel of the tooth when cutting.

(d). The discussion so far has assumed the cutter to be milling a slot of a width equal to its diameter. This is not always the case. The cut may vary from the diameter of the cutter down to practically nothing. The less the depth of cut below the point K, Fig. 1, the less is the clearance required on the cutter for a given ratio of feed per revolution to cutter diameter. For light finishing cuts very little clearance is therefore necessary.

(e). Hence it is evident that a cutter ground for a light surface cut will not work properly on a deep cut unless the feed is correspondingly reduced. Conversely, a cutter ground for a deep cut can be fed much faster on a light cut.

Positive Rake of Milling Cutter Teeth.

Since milling cutters for steel and iron are almost all made with radial faces, the idea is prevalent that the cutting action of the teeth is much the same as that of a planer tool which has no top or side rake, cutting as shown in Fig. 4, with the face of the tool at right angles to the direction of feed. This analogy is nearly true for slow feeds; but if we examine in Fig. 2 the angle which the face of the tooth makes at E with the tangent $E\,H$ to the cutting curve, we see that for this coarse feed the tooth has considerable top rake as indicated by the angle a. This fact throws some light onto the reason why coarse feeds are more efficient than fine ones for removing metal. By efficiency we mean the capacity for removing metal, as measured in such terms as pounds of metal per horse-power per hour. On all tools, where practicable, rake is used because of its distinct advantage as a power saver. Consideration will be given later to the relation of coarse feed to the number of teeth in a cutter.

Milling cutters whether with fine or coarse teeth will produce a very flat surface no matter whether the feed be fast or slow. This is evident by examining the cutting curves in Figs. 2 and 3 at the point R, Z, S_3 and S_2. They are nearly flat. In Fig. 3, as the tooth S_3 moves to T, the tooth Q moves to U in a path similar to the end of the cycloid at $M\,S_2$. The two curves would cross midway between U and S_3 at a point N. The height of N is very little above the line S_3U. For fine feeds this height would become infinitely small.

The ridges so often thought to be due to coarse feed are due to the cutter being run out of true, *i. e.*, eccentric. This action is caused by a number of things such as untrue spindles, sprung arbors, and cutters with holes too large for the arbor, or even by cutters ground on sprung arbors, etc. The common effect of all these causes is that the cutter mills deeper at one part of the revolution than another. The number of turns it makes in crossing a piece of work may be found by counting the ridges produced.

It is thought by many that a spiral tooth cutter will mill a flatter surface theoretically than a straight tooth cutter. This is only true practically, because the spiral action prevents vibration. Theoretically, the only difference would be that the ridges produced by one would be parallel to the spindle while the other would be diagonal.

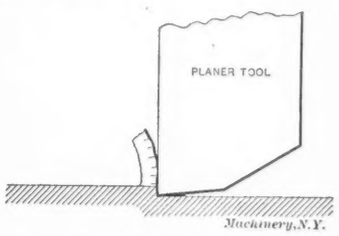


Fig. 4. Planer Tool without Front Rake.

Chattering.

Chattering is due to variations of pressure between the cutter and the work. When a corner of the work advances toward a cutter, as in Fig. 5, point A, the first tooth to strike it springs back as it cuts. As it passes the corner it jumps forward. This action is repeated by each tooth and it sets up a vibration of the cutter and arbor which continues until the cut is well under way, as at C, Fig. 5. If the cutter has excessive clearance, the vibration will cause it to feed deeper than necssary at the instant when the cutter vibrates toward the work. This action causes the formation of notches. These notches or grooves once formed are apt to follow clear through the cut and keep up the chattering.

The vibration is begun by the intermittent action of one tooth. Soon two teeth begin to cut part of the time (see position *B* in Fig. 5). Here the pressure variation becomes due to the difference between one tooth and two teeth. As soon as three teeth begin cutting part of the time, the pressure variation is between two and three teeth, and so on. The more teeth bearing on the work at one time, the less is the pressure variation.

We have assumed above the use of straight face cutters; but they are not always used. The best practice recommends cutters with a slight spiral. Then the initial shock is reduced and the first tooth takes an appreciable time to perform its cut. On wide cuts it is practical to have the second tooth begin cutting before the first finishes its cut. Still there exists a variable pressure which can cause vibration, though it is not so great as with a straight face cutter.

A given combination of cutter and arbor will have a definite period of vibration, just as a violin string of given length, thickness and tension will vibrate at a definite rate and produce a certain sound. Sometimes the spindle speed and cutter pitch are such that they cause chattering that matches closely to the period of vibration of the cutter and arbor. They may be said to be in tune, though the noise that results is frequently anything but music. This can happen with spiral cutters as well as with straight tooth cutters, though the action will not be so pronounced.

The remedy is twofold: Reduce the clearance, if excessive; change the spindle speed. A change of feed will have little effect except as it tends to make use of excessive clearance. Using a cutter of different diameter will frequently help, beause it breaks up the noisy combination.

Number of Teeth.

The considerations that govern the number of teeth in a cutter are as follows:

(*a*). Degree of finish required.

(*b*). Depth of cut.

(*c*). Amount of metal removed per revolution.

(*d*). Kind of material being cut.

There are other considerations that depend more or less on these, and these four depend a great deal on each other.

(*a*). A fine tooth cutter will produce a better finish for a given speed and feed than a coarse tooth cutter. Since finishing cuts are light, the use of a coarse tooth cutter would

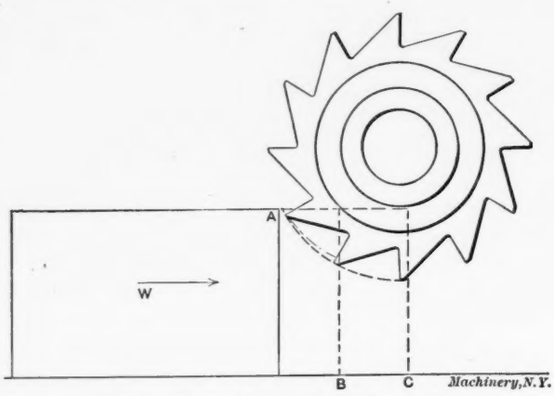


Fig. 5. Action of Cutter, just Starting to Cut.

cause chattering because of the variation of pressure due to the probable action of one or two teeth intermittently, as before noted; hence finer tooth cutters are better for finishing.

(*b*). The deeper the cut the more teeth of a given cutter will be in action at one time. There is no object in having this number too large. In fact, it is a distinct disadvantage, because the feed has to force all the teeth into the work.

(*c*). The amount of metal removed per revolution depends on the rigidty of the work, *i. e.*, the method of holding it, and its capacity to withstand the pressure of the cut. The space between two cutter teeth has to carry the metal removed by one tooth during its cut. The area of this space varies as the square of the pitch of the teeth. Hence the relative ability of the space to carry away metal becomes greater as the pitch increases. Coarse teeth are therefore best fitted for rapid cutting. It might seem that coarse feeds require extra power in proportion as they are increased. This is not so, because the top rake or wedge-like action of the teeth makes it easier for them to enter the work. As the feed is increased the top rake is increased, hence the resistance increases at a slower rate. It might be mentioned that the top rake is equal to the theoretical clearance required at the point under consideration. This is true when the face of the tooth is radial.

(d). The kind of material to be milled affects the pitch of the teeth in general, as follows: The harder the metal, the fewer the teeth or coarser the pitch; the softer the metal, the finer the pitch, because the cutter must have some support at its cutting edges or it will enter the work too eagerly. For soft metals, such as brass, the additional precaution is taken of making the teeth faces slant ahead of the axis of

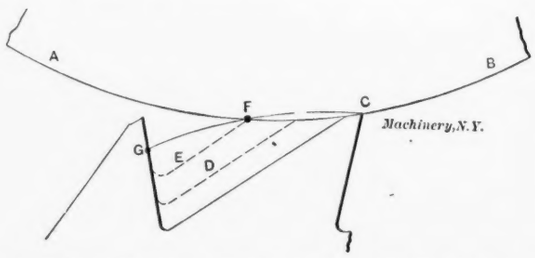


Fig. 6. Effect on Clearance caused by repeated Grinding of Cutter Teeth.

the cutter instead of radial. This reduces the top rake. The spiral of cutters is more rapid on cutters for soft metals, because of the greater danger from chatter.

Diameter of Cutter.

For a given feed per tooth and a given pitch, a reduction of the diameter of the cutter has the effect of increasing the necessary clearance and the resulting top rake. It also decreases the torsional strain on the arbor, the shearing stress in the cutter key, and the frictional force in the spindle taper. It reduces also the strain thrown on the driving gears of the spindle, and a saving of metal in the cutter is affected, but since the number of teeth are fewer, they are used oftener and wear out more quickly. Experience seems to prove the advisability of using cutters as small as possible without reducing too much the rigidity, or the reasonable allowance for recutting.

Grinding Cutters.

Consider a given cutter running always at the same feed per tooth. In Fig. 6 two teeth are drawn with the cutting curve *C F G* between them. The arc *A B* represents the position of the grinding wheel when grinding the clearance which was necessary when the cutter was new. The dotted lines *D* and *E* represent the flank of the tooth at two stages of its life before recutting. When regrinding has brought the flank to *E*, the heel of the tooth *F* will lie on the cutting curve. To lower this point below the cutting curve requires a smaller wheel. But this has the effect of weakening the cutting edge at *C* by reducing the angle of the point. This makes overheating more likely to occur.

Cutters should seldom be ground away so much as shown here because the space between the teeth is reduced so much that it will not carry the chips away properly. When the distance *F C* becomes half the pitch, the chip space becomes nearly one-fourth what it was originally.

The previous discussion seems to suggest the necessity of having some means of modifying the clearance ground on a cutter so that its performance will be uniform after successive grindings. In this way the maximum results would become more nearly possible, because another of the uncertainties in the use of milling cutters would be eliminated.

* * *

"Alas!" confessed the penitent man, "in a moment of weakness I stole a carload of brass fittings."

"In a moment of weakness!" exclaimed the Judge. "Goodness, man! what would you have taken if you had yielded in a moment when you felt strong?"—*Exchange.*

MAKING SAWS.

ETHAN VIALL.*

Owing to the fact that many of the machines used in saw manufacturing are designed and made by each firm for its own use, and also to the fact that many of the processes in saw making have been developed along independent lines, there are many things in a saw factory which are not generally known, and the processes are often regarded as trade secrets. However fallacious this policy of secrecy may be, it is followed by nearly all saw manufacturers; yet it is safe to say that not one firm is in ignorance of the important processes and methods used by its competitors.

E. C. Atkins & Co., of Indianapolis, Ind., is one of the few saw manufacturers realizing the futility of trying to keep their machines and processes secret. This firm, which is one of the largest and oldest manufacturers of saws in the United States, through the courtesy of Mr. Atkins, the superintendent, gave the writer the opportunity of taking a number of photographs, and obtaining the information necessary to give the readers of MACHINERY an idea of how the Atkins saws are made. This company turns out thousands of hand saws, but the main product is large circular and large band saws. The circular saws are of two general types, the solid and the inserted tooth.

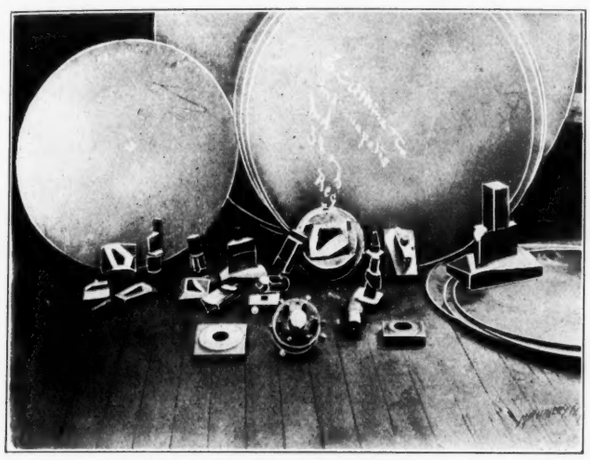


Fig. 1. Steel Disks for Circular Saws, and Punches and Dies for Center Holes and Teeth.

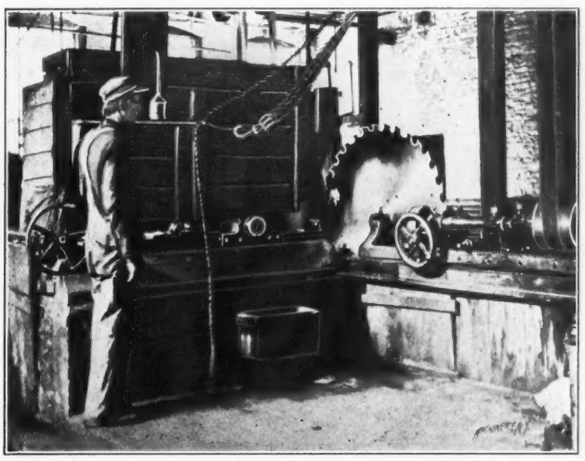


Fig. 2. Machine for Grinding the Sides of Circular Saws.

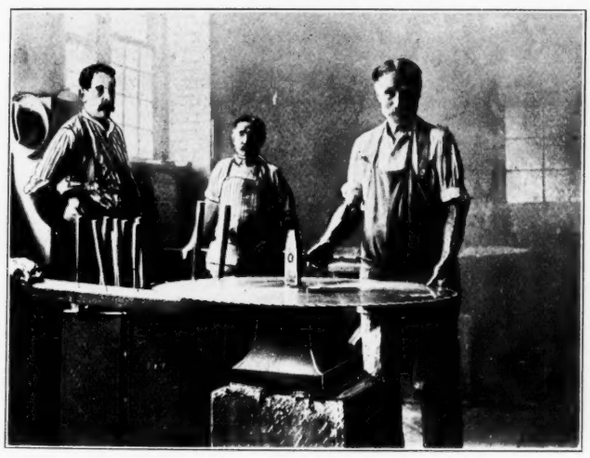


Fig. 3. Hammering and Tensioning a Circular Saw.

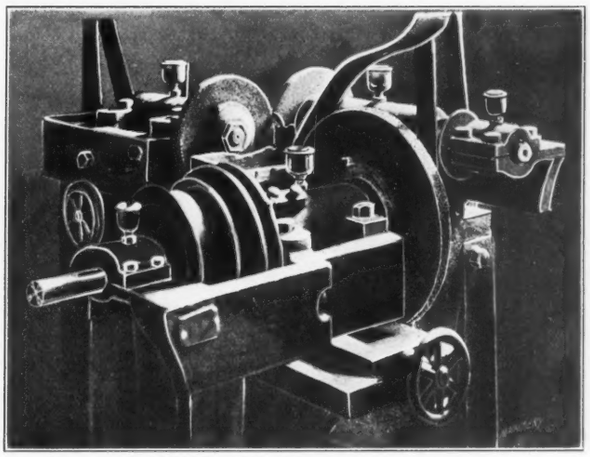


Fig. 4. Special Three-wheel Grinder for Grinding the Teeth of Inserted Tooth Saws.

The steel for the saws, which is made especially for the firm, comes in circular disks or in long strips or bands of the proper size and standard gage for the various standard circular and band saws made. A number of the steel disks from which the circular saws are made, are shown in Fig. 1. Several center hole and tooth forming punches and dies are also shown in this engraving.

In working up the steel disks into saws, the center hole is first punched in a punching press, and in the next operation the teeth are cut. The operator selects a tooth-forming punch and die corresponding to the number of teeth required. These are set up in the press and an indexing disk of the same number of teeth as required in the saw is placed on a stud, as shown at *A* in Fig. 5. The saw blank is then placed over this indexing disk and securely clamped, by means of a nut on the stud. The carriage holding the blank is then moved in or out, and the entire fixture moved to the right or left, until the disk is in the correct position for the punch to cut the teeth at the proper angle and depth. The teeth are then rapidly cut, the spacing being obtained by the indexing plate. All of the circular and inserted tooth saws are cut out by using this kind of punch press jig.

When hardening the saws, they are laid flat in a special gas furnace, and heated slowly. When evenly heated, the saw is drawn out and placed on the lower plate of a grated clamp, as large or larger than the saw, and a similar grated plate is lowered from above. The saw is thus kept flat, and prevented from warping, and is quickly lowered into a large tank of oil. When the saws are taken out of the hardening bath, they are placed in the machine shown in Fig. 2, where the sides are ground. This machine is provided with a large grindstone, which is fed in or out by means of a hand-wheel, shown just back of the operator. The saw is placed on an arbor mounted on a carriage which automatically feeds it across the face of the grindstone. The grinding begins at the outer edge of the saw, and as the operation proceeds, and the grindstone is gradually fed in toward the center, the saw is made thinner in the center than at the edge. This method provides a free-cutting saw with little tendency to bind.

While grinding, the saw revolves in the same direction as the grindstone, but more slowly, as belt-driven rolls, one on each side of the saw, act as brakes, and thus make grinding possible. The practice of running the saw in an opposite direction from that of the wheel, usually followed in grinding small milling saws, would be practically impossible in this case, owing to the leverage caused by the size of the

* Associate Editor of MACHINERY.

saw and the width of the grinding wheel. Besides, it is doubtful if there be any advantage in running the saw and wheel in opposite directions.

During the grinding process, water pours down between the saw and the stone, and only a few minutes are required to grind the sides of the largest saws, with no danger of drawing the temper. After grinding the sides of the saw, it is placed on an arbor in another machine, and while revolving rapidly, is polished by holding a polishing pad with a wooden handle against the side and feeding it back and forth on the top of the rest, as shown in Fig. 6. Flour of emery is used on the pad for polishing. Then the teeth are touched up on a special grinding machine, as shown in Fig. 7.

One of the most important operations on the saw is the hammering and tensioning. This work is tedious—or at least it looks so—and it takes long practice to become an expert. Twenty-five or thirty men are employed in this department, and a large majority of them are well past middle age, and have been doing this work for years. Fig. 3 shows the shape of hammers and the anvil used for hammering the large circular saws. As few mechanics outside of saw-mill men know what "tensioning the saw" means, the following is quoted from a pamphlet of instructions issued by E. C. Atkins & Co. for their customers.

"For the benefit of our patrons and sawyers using our saws, we take pleasure in explaining the general principles involved in the hammering and tensioning of circular saws. The practice taught by masters of the art thirty years ago, when only saws of small diameter were used, was that a circular saw, to do proper work, should be left firm between the center and the

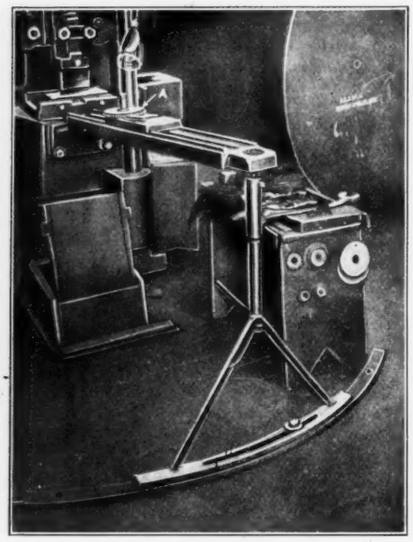


Fig. 5. Indexing Jig used when Punching Circular Saw Teeth.

Fig. 6. Polishing Circular Saws.

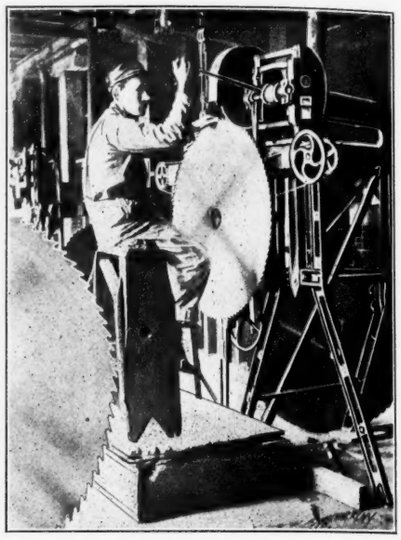
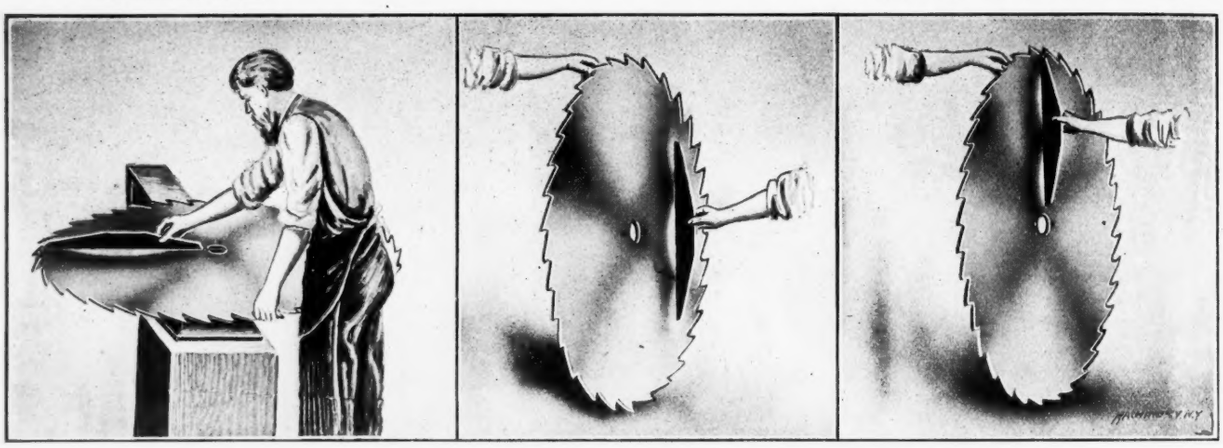


Fig. 7. Grinding Machine for Touching up the Teeth of Circular Saws after Hardening.



Figs. 8, 9 and 10. Testing the Sides of a Circular Saw to Determine the need of Hammering and Tensioning.

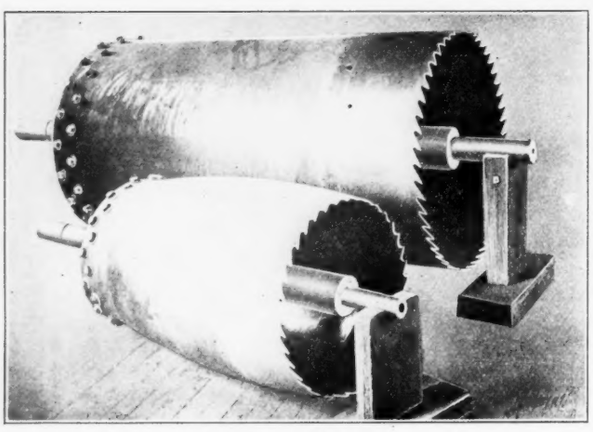


Fig. 11. Barrel Saws.

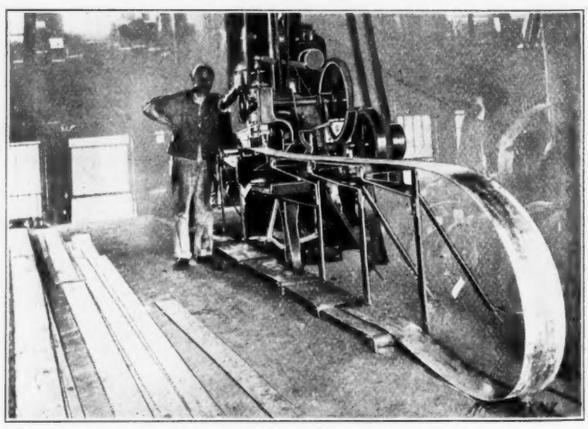


Fig. 12. Punching the Teeth in Band Saws.

rim, and open as to its whole diameter, whereas experience has shown that it is best to open out the body of the saw between the center and the rim to the extent required for the speed the saw is to run.

"Very high speed and thin saws require that the saw be opened out until it takes a strong push or pull to throw the center either way when the saw is standing upon the floor. When the saw is in proper tension and is shaken, the body only of the saw should vibrate, while the rim should be nearly or quite steady.

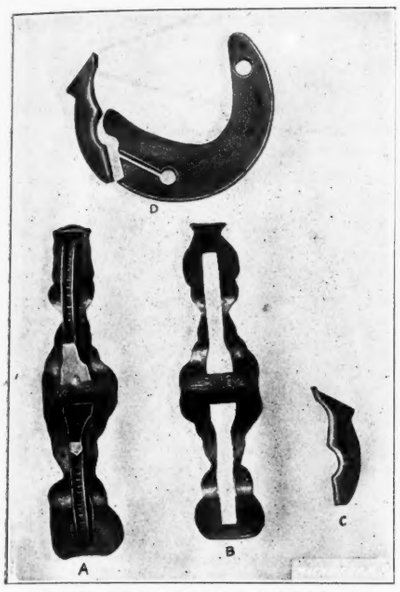


Fig. 13. Forging for Tooth and Holder for Inserted Tooth Saws.

"Gumming a circular saw, or alternate heating and cooling of the rim, will permanently expand a saw at the rim, and in consequence it will become too stiff in the center or body, and run 'snaky.' A few strokes of a round-faced hammer on both sides of the saw at the proper place will restore the tension. In Fig. 17, the portion of the saw to be hammered is indicated by the dotted lines. The same treatment is required if the saw is put up for too low speed. The rule is that it must be more open or 'limber' in the body of the saw for fast speed than for slow; for hard than for soft wood.

"When the saw is standing on the floor and shaken with the hand and the center and rim both vibrate, it requires more hammering on the line next to the rim. When opening out the body of the saw, do not hammer within 6 inches to 10 inches of the center.

"Observe the motion of the saw when on the mandrel and running up to full speed; if it runs wavy on the rim, it needs opening out on the dotted lines. If it runs steady and true out of the log, it is the fault of the hanging, lining, fitting or management if it does not run steady and true in the log.

"To equalize the tension, the parts that drop least require hammering until the tension is even and all parts indicated by the dotted lines drop equally all around the saw, the center line dropping a little more than the others.

"Hammering to take out lumps should always be done on the high side or on that side which touches the straight-edge. Lumps or ridges upon or near the rim may be found with the straight-edge by examining that part of the saw, with the center of the saw resting on the anvil, but lumps or ridges in the body should be found with the saw standing perfectly perpendicular upon the floor, Figs. 9 and 10. Mark the high spots with chalk, and hammer where marked, on an anvil.

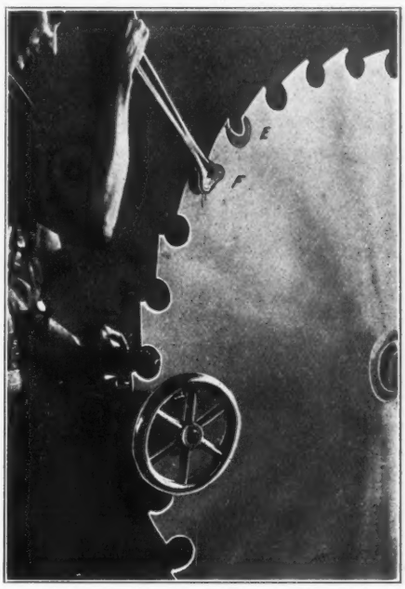


Fig. 15. Inserting the Teeth.

"Allowance must be made for change in tension produced by the blow of the hammer, as every blow stretches and opens the saw at the point struck.

"Lumps usually run in ridges and should be hammered out with a cross peen hammer, the peen following the ridge in the direction in which it runs as discovered by the straight-edge. Round lumps may be hammered down with the round face hammer, or with a cross peen hammer, by changing the position of each blow so that the strokes cross each other. The strokes should be directly on the lump or ridge."

The foregoing extract will not only give a good idea of what hammering and tensioning means, but it will also give a fair idea of how it is done.

In the inserted tooth circular saws, the cutting teeth are forged in pairs, as shown in Fig. 13, where *A* is the forging untrimmed, *B* the part trimmed off, and *C* the tooth. At *D* is shown the tooth and holder ready to be put into the saw.

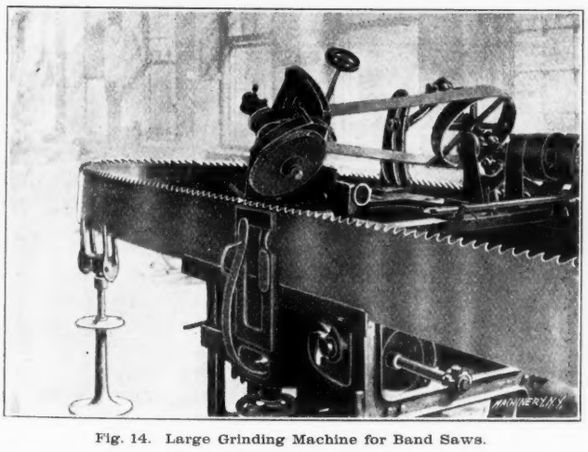


Fig. 14. Large Grinding Machine for Band Saws.

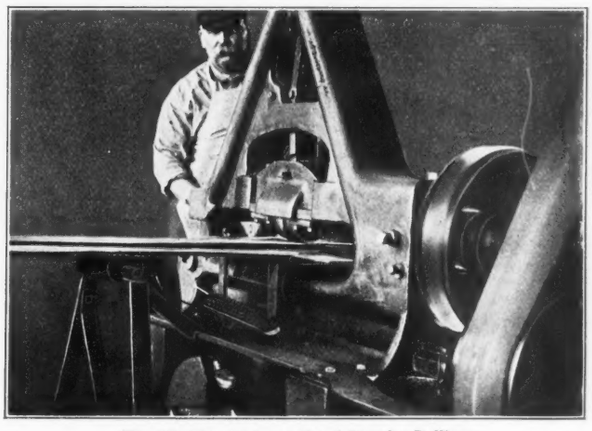


Fig. 16. Tensioning a Band Saw by Rolling.

"Fig. 8 illustrates the examination of the saw with the straight-edge in adjusting tension: the center of the saw resting on the anvil, the rim back of the anvil supported on a narrow bench extending from the anvil to the wall, and the opposite point raised with the hand, the straight-edge extending from the center toward the rim of the saw. If the saw is properly opened in the body, the portions indicated by the dotted lines in Fig. 17 will drop away from the straight-edge equally all around the saw.

The teeth are ground on both sides and on the cutting edge at one operation, on a special three-wheel grinder, shown in Fig. 4. The manner in which the tooth-holder or "shank" is inserted is shown in Fig. 15, one tooth being already in place at *E* and another just being put in with a wrench at *F*. The saw is held in position by a stud which passes through the center hole and by a clamp, operated by a hand-wheel, which grips the rim.

A special form of saw called the barrel saw, which is used

for sawing out barrel staves, is shown in Fig. 11. In these saws only a narrow strip at the edge is made of saw steel, the body being made of a cheaper material, to which the saws are brazed. The cutting blades are made in the same way as a band saw, with the ends lapped and brazed.

In making band saws, the teeth are cut in a punch press, as shown in Fig. 12, the teeth being set against a stop the right distance from the punch, and the feeding being done by hand. These saws are hardened by fastening them to a "dummy" strip, which is slowly drawn through a gas furnace and into an oil tank. The whole operation is continuous and practically automatic. After hardening, the band saws are ground by feeding them under a large grindstone. The table is tilted so as to grind the saws thinner at the back.

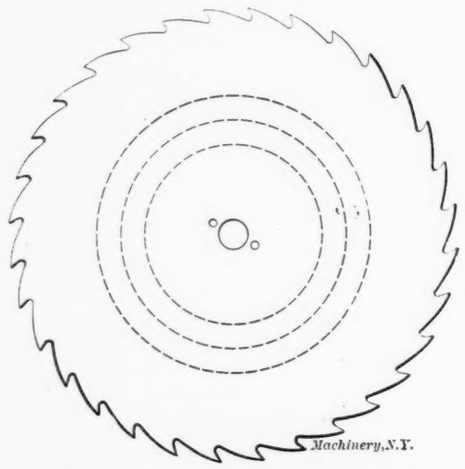
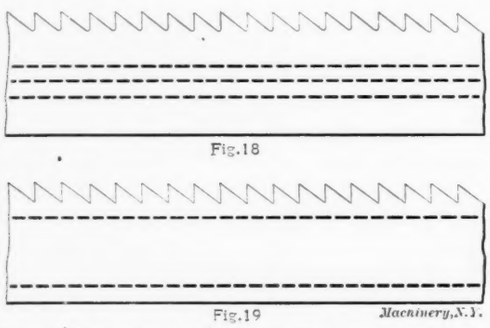


Fig. 17. Diagram Indicating the Lines along which a Circular Saw is Tensioned.

An automatic band saw tooth grinder is shown in Fig. 14. This grinder will take saws of any size and length; for small saws of similar type, smaller machines of the same design are used. These smaller machines are common in wood-working shops.

The manner in which band saws are rolled to give them the proper tension is shown in Fig. 16. To run properly, a band saw must be open in the middle, and it is rolled as shown by the lines in Fig. 18. If it is too open, it is rolled as shown in Fig. 19.

Hand saws and cross-cut saws are both ground thin on the back, the same as the band saws, and in the same way. They



Figs. 18 and 19. Lines along which a Band Saw is Tensioned.

are heated and held in long clamps while being dipped in the hardening oil bath. The teeth on the hand saws are set with a light hammer. The men engaged in this work, the setters, use their hammers as steady as the ticks of the clock and never miss a tooth.

* * *

The length of new railways opened in the United States last year was 3,214 miles, showing a decrease of 1,998 miles, or 38 per cent, as compared with 1907. The largest new construction on the part of any one company was 790 miles of track involved in the Chicago, Miiwaukee and St. Paul Railroad's Pacific Coast extension. The railway network of Canada was increased last year by 1,250 miles, and that of Mexico 435 miles.

JIGS AND FIXTURES—12.

BORING, REAMING AND FACING TOOLS.

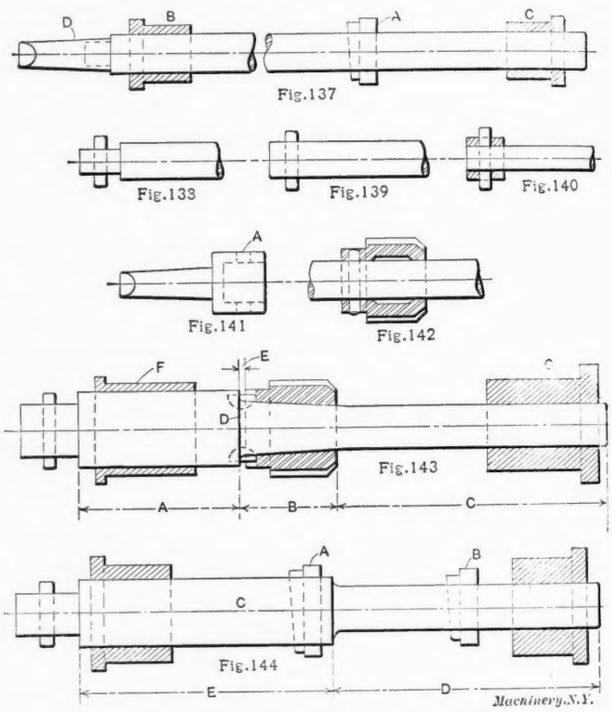
EINAR MORIN.*

More or less elaborate tools or sets of tools are required for the various boring operations performed with or without boring jigs. These tools comprise boring, reaming and facing bars, boring and facing cutters, solid or shell reamers, boring and facing heads, bushings, stops, drills, collets, and knuckle or universal joints.

Boring Bars.

The general requirements of a boring bar are that it must be as heavy and rigid as possible, straight, and ground concentric, and a good running fit in the bushings. When the bar has been turned and once ground to the right size, it should never be put in a lathe and filed, or emery cloth used on it. Boring bars are made from machine steel and are not hardened. Sometimes small bars are made from tool steel and hardened, in order to give them additional stiffness. Shanks for reamers, and facing bars, should be made in the same way as boring bars, but if possible, should be even stiffer.

The most common type of boring bar is shown in Fig. 137, the cutter *A* being located at about the middle of the bar,



Figs. 137-144. Boring Bars of Different Types.

and the bar being guided at both ends by bushings *B* and *C*. The bar is provided with a taper shank at *D*, fitting the spindle of the machine or a collet connected with a knuckle joint. It is quite common practice to turn down the end of the bar, as shown in Fig. 138, to fit the knuckle joint or collet shown in Fig. 141. Sometimes, of course, the bar can be left full size, as shown in Fig. 139, and sometimes the end is even made larger than the bar, by forcing on a collar, as shown in Fig. 140, in order that the end may fit the driving collet. A key is passed through the end of the bar for driving it; this key fits in the slot *A* in the collet shown in Fig. 141.

The bar shown in Fig. 137 can also be used for facing purposes, the cutter *A* being taken out, and a facing cutter inserted. The same bar can also be used for a special shell reamer, when this has a straight hole, the reamer being held to the bar by a taper pin, as shown in Fig. 142. Standard shell reamers have a taper hole, and for these, the bar must be turned with a taper part, as shown in Fig. 143, where the part *A* is turned up to the largest size possible (generally 1/32 or 1/16 inch under the diameter of the reamer); part *B*,

* Address: Borlänge, Sweden.

being turned to fit the taper hole in the shell reamer, is left long enough to permit the reamer being pressed up tightly without touching the shoulder *D*. As a rule, the taper part is so dimensioned that ⅛ inch will be left at *E*, between the shoulder of the bar and the back of the shell reamer, when this is forced up as far as possible. The reamer is driven by keys or pins entering in a slot cut across the end of the reamer. The part *C* of the bar is turned down to some standard size, just below the size of the small end of the taper hole in the reamer. The bushings *F* and *G* may be made with the same outside diameter, fitting the same size lining bushings in the jig, their inside bearings being made to fit the large and small diameters of the bar.

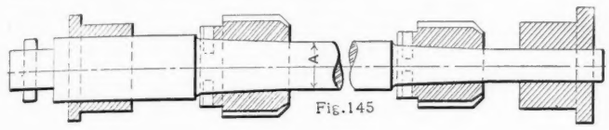


Fig.145

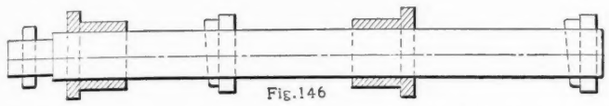


Fig.146

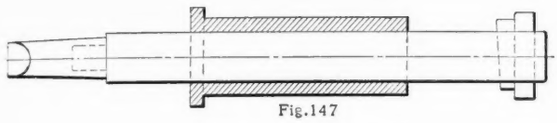


Fig.147

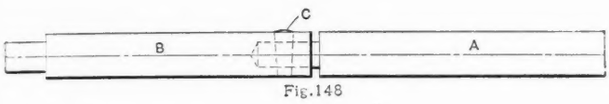


Fig.148

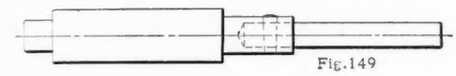


Fig.149

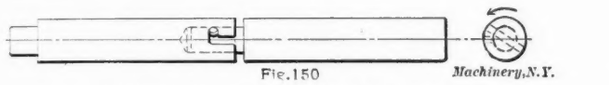


Fig.150

Machinery,N.Y.

Figs. 145-150. Other Designs of Boring Bars.

A boring bar used for boring out two holes of different size may be made as shown in Fig. 144; *A* and *B* are the cutters for the two holes, and part of the bar *C* is turned down for a length, *D*, to suit the small hole. The part *E* can then be made of as large diameter as permissible for boring out the hole for which the tool *A* is used. By making the bar in this way, a more rigid construction is possible than if the part *E* were turned down to the smaller diameter required by the hole bored by cutter *B*. There may be more than two holes of different sizes in succession, and then the bars may have a greater number of steps; if there is but a slight difference in the sizes of the holes to be bored out, it hardly pays to turn down steps on the bar. The stepped bar may also be used for facing bars. While these small matters may seem unimportant and elementary, they must be taken into consideration when designing a set of expensive tools for boring jigs which are to be in constant use.

Reamer bars used for reaming out two or more holes simultaneously may be made as shown in Fig. 145, providing the diameter *A* is large enough for turning the taper portion for another shell reamer of smaller size. Should the diameter be too small to permit this, an extension can be provided, or a separate bar used for the smaller reamer. The principle of stepped bars can be applied also where the cutters are placed as illustrated in Fig. 146, where one boring cutter or facing tool is placed at one end, the bar still being guided by two bushings.

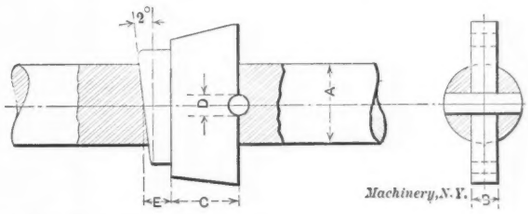
A boring, facing, and reamer bar used almost as commonly as the one already described, is illustrated in Fig. 147. The principal features of this bar are that the cutting tool is always located at the end of the bar, opposite to where it is driven, and that there is but one bushing for guiding. This bushing should be as long as possible to give a good bearing, and prevent the bar from wobbling. Sometimes, as illustrated in Fig. 121, January issue, the jig is made with two bearings which, however, are on the same side of the cutter, and a comparatively short distance apart.

Sometimes a bar must be made in two parts. The reason may be that one solid bar would be too long to permit of its being pushed into the jig from one side. Another reason may be that the cutting tools are too large to pass through some intermediate hole. The two parts of the bar may be connected with a taper pin, as shown in Fig. 148, the end of bar *A* being a sliding or driving fit in the hole in section *B*. This bar should be ground after the two parts are assembled, so that they will run exactly true with each other. A stepped bar made up of two sections as shown is Fig. 149. In Fig. 150, another method of connecting the two sections is shown; when this method is used the two bars can be put together and taken apart very rapidly. This method can also be used to connect two bars by a separate piece, as shown in Fig. 151, the two sections being bored out to fit the intermediate piece, which has two pins *A* and *B*, driven into it, and transmitting the motion from one section of the bar to the other, as indicated. It is evident that two bearings would hardly be sufficient for this class of boring bars. When these bars are used, three or more bearings should be provided. This type of bar, however, is not used to a very great extent.

Cutters for Boring Bars.

The cutters used in boring bars vary widely. The cutter *A*, Fig. 152, is commonly used. It cuts with both ends, and is centered by the two flats *B*, milled or filed on the bar; a slot is provided in the cutter, which fits these flats of the bar. After the cutter has been put in place, it is tightened by the key *C*, and is turned to the correct diameter required, and then hardened. A more modern arrangement is shown in Fig. 153. The cutter here is a plain rectangular piece of steel, cutting with both ends. It is centered by the pin *A*, which is driven into a hole drilled so that one-half of it passes through the slot in the cutter. As in the former case, the cutter is turned down to the right diameter when in place. It is tightened down by the key *B*. This way of locating the cutter centrally has proved very satisfactory. In Table X are given dimensions of cutters for different bar diameters.

TABLE X. BORING AND FACING CUTTERS.



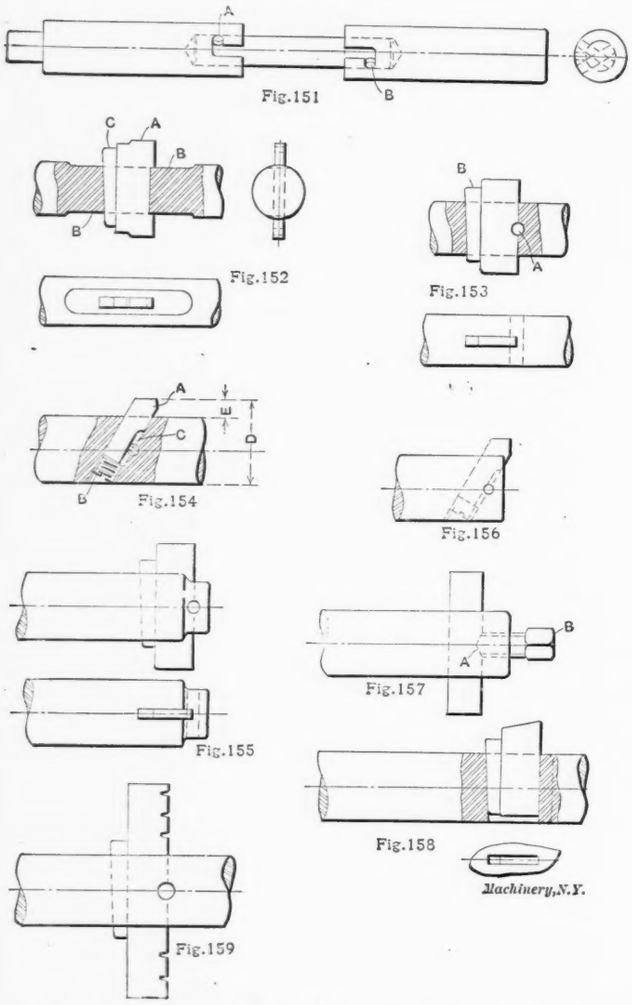
Machinery,N.Y.

A	B	C	D	E
¾ to 15/16	¼	⅝	3/16	¼
1 to 1⅜	⅜	⅝	3/16	¼
1½ to 2	⅜	⅝	¼	¼
2½ to 3	½	1	¼	5/16
3½ and larger	½	1¼	5/16	5/16

Facing cutters may be located and held in place in the same way. They are longer than boring cutters, being intended to finish a boss or seat around a hole, but otherwise they are made to about the same dimensions.

Single-ended boring cutters, as shown in Fig. 154, are used to a great extent, and it is claimed that they give a more perfect hole. The illustration shows a common way of securing the tool; the cutter *A*, which is made of drill rod or other round tool steel stock, fits a hole bored at an angle of sixty degrees with the axis of the bar, and is adjusted by the headless set-screw *B*. When adjusted, the cutter is held rigidly in place by the pin *C* provided on one side with a flat tapering portion, which fits against the flatted side of the cutter, as shown in the engraving. This cutter is very easily set by taking a measurement *D* with a

micrometer. Subtract from the dimension *D* the diameter of the bar, thereby obtaining dimension *E*. Now add *E* to *D*, thereby obtaining the diameter of the hole which will be cut. The screw may have to be adjusted a few times, to obtain the desired result. Table XI gives dimension for this kind of cutter, and also for screws and pins used with them. The two kinds of cutters referred to may also be used on the ends of the bars, as shown in Figs. 155 and 156. The cutter of the type shown in Fig. 153 may be held in either of the two ways shown in Fig. 155 and Fig. 157. In the latter case, the cutter is spotted at *A*, and held by a pointed screw *B*. This method, however, does not always insure very accurate results. The simplest kind of single-ended cutter, and the manner in which it is held is shown in Fig. 158. It may be used in any kind of bar, and, with ordinary care, good results may be obtained even with this simple tool. The variations possible are many, and the examples shown simply indicate the most common practice.



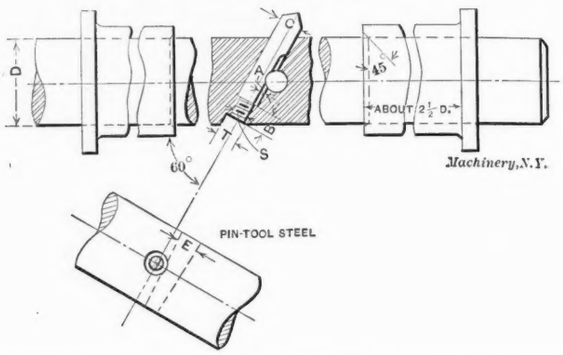
Figs. 151-159. Different Types of Cutters and Methods of Fastening.

Facing cutters may be made similar to boring tools, or they may be made with teeth, like end milling cutters, as illustrated in Fig. 161. In this engraving, one of the cutters *A* cuts with both sides, while the cutter *B* cuts with one side only. The bar is provided with a slot and with notches for locating and holding in place the various cutters, as shown at *C*. A pin *D* is driven into the cutter, and enters the notch, thus driving the tool. The cutters can also be held on the bar by taper pins, but the putting in place and the removal of the cutters would then be much slower.

Different cutters are commonly used for roughing and finishing. To make it easier to remove the metal with the roughing cutter, it may be made with every other tooth beveled in opposite directions, as shown in Fig. 160, where *A* is one tooth beveled towards the center, and *B* the next tooth beveled outwards. Using a cutter of this kind will produce a surface as indicated at *C*, which must be faced square by a finishing cutter.

In order to face the work to correct dimensions, stops are sometimes provided which strike against some finished surface on the jig which stands in a given relation to the finished surface on the work and the cutting edge of the facing cutter. Such a stop may be made as shown at *E* in Fig. 161, and be held and located in the same way as the facing cutter. The stops are made of machine steel, case-hardened, and ground on the bearing surface. When facing up a wide surface with an inserted blade facing tool, it is often the practice to cut small notches in the blade, as shown in Fig. 159, the cutting edges on the one end overlapping the notches on the other. Very often the holes to be bored are too large to permit of cutters, such as previously described, being used, and then it is necessary to provide the boring bars with a boring head. A simple boring head is illustrated in Fig. 162, where *A* is the head held on the bar by a taper pin; *B* is a boring tool which fits in a slot in the head, and which can be adjusted out and in by the screw *C*, which passes through the shoe *D*, which also fits the slot, and against which the cutter is located, as illustrated. The cutter and shoe are held by the bolt *E*. The bolt is milled flat on one side so that a hook is formed for binding the cutter and shoe. Two or more cutters may be used in these boring heads. At *F*, in Fig. 162 is shown a facing tool used in the same head as the boring tool. No adjusting shoe is necessary in this case, as the facing cutter bears directly against the bottom of the slot in the head, and against the boring bar, and is held by a bolt *G*, milled with a tapering flat on one side, which wedges the cutter into its seat. More complicated boring heads are provided with a small slide for adjust-

TABLE XI. BORING BAR CUTTERS.

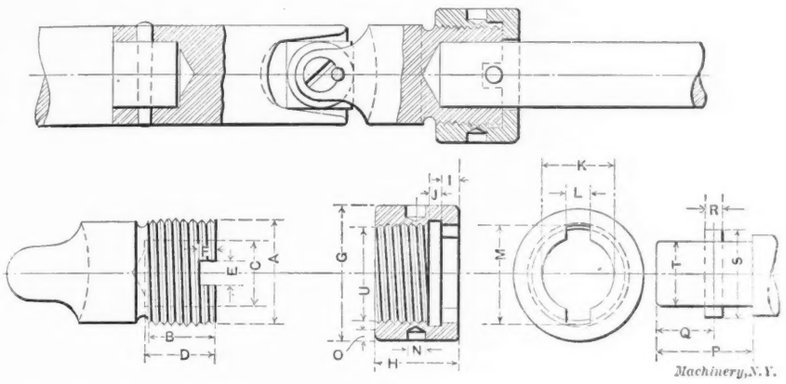


D	C	E	A	S	T	B
Diameter of Bar.	Diameter of Cutter.	Diameter of Pin.	Depth of Milled Down Part.	Diameter of Screw.	Diameter of Counterbore.	Length of Thread.
3/8	1/8	1/16	1/64	1/16	1/8	5/64
7/16	1/8	3/32	1/64	1/16	1/8	5/64
1/2	1/8	3/32	1/64	1/16	1/8	5/64
9/16	1/8	1/8	1/32	1/8	5/32	1/8
5/8	3/16	1/8	1/32	1/8	5/32	1/8
11/16	3/16	5/32	1/32	1/8	3/16	5/32
3/4	3/16	5/32	1/32	3/16	3/16	5/32
13/16	1/4	5/32	1/32	3/16	1/4	3/16
7/8	1/4	5/32	1/32	3/16	1/4	3/16
15/16	1/4	3/16	1/32	3/16	1/4	1/4
1	1/4	7/32	1/32	1/4	1/4	1/4
1 1/8	5/16	1/4	1/32	1/4	5/16	5/16
1 1/4	5/16	1/4	1/64	1/4	5/16	5/16
1 3/8	3/8	1/4	1/64	5/16	5/16	5/16
1 1/2	3/8	9/32	1/64	5/16	3/8	3/8
1 5/8	7/16	5/16	1/64	3/8	7/16	7/16
1 3/4	7/16	11/32	1/64	3/8	7/16	7/16
1 7/8	1/2	3/8	1/16	7/16	1/2	1/2
2	1/2	13/32	1/16	7/16	1/2	9/16
2 1/8	9/16	7/16	1/16	1/2	9/16	9/16
2 1/4	9/16	15/32	1/16	1/2	9/16	5/8
2 3/8	5/8	1/2	5/64	9/16	9/16	11/16
2 1/2	5/8	17/32	5/64	9/16	5/8	11/16
2 5/8	11/16	9/16	5/64	5/8	11/16	3/4
2 3/4	11/16	19/32	5/64	5/8	11/16	3/4
2 7/8	3/4	5/8	3/32	5/8	3/4	7/8
3	3/4	9/16	3/32	5/8	3/4	7/8

ing the tools, and some are made similar to the box tools used in turret lathes.

The reamers most commonly used in connection with the boring jigs are shell reamers of standard make. Many concerns have been in the habit of making their own shell reamers with inserted blades, designed about as shown in Fig. 163; *A* is a machine steel body, and *B* a tool steel blade, which is made tapered as shown, and driven into place. When the blades are inserted in the body, the reamer is ground. The reamer can be re-ground when dull, and kept to standard size, by forcing up the blades along the taper. The bodies of very large inserted-blade reamers are made of cast iron.

TABLE XII. BORING BAR COUPLINGS.

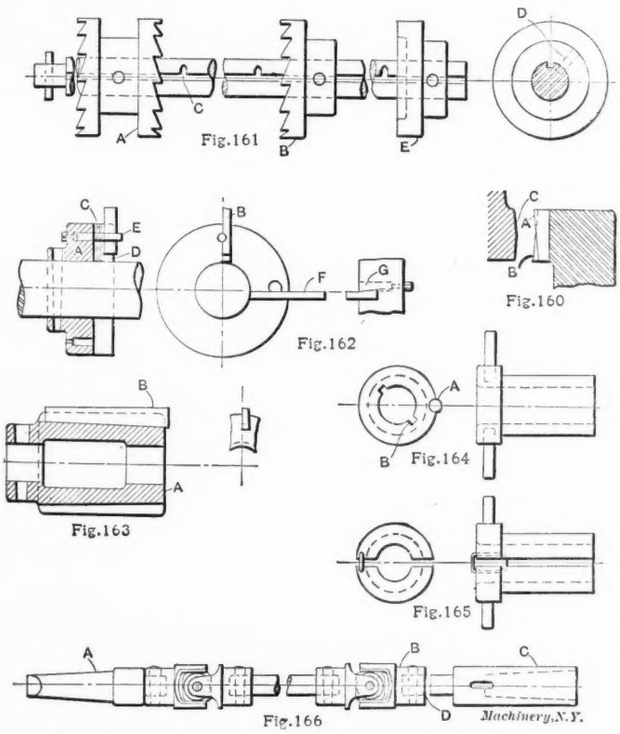


Machinery, N.Y.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U, Bore.	Threads per inch	Used for Bars.
$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{7}{16}$	$\frac{3}{16}$	$\frac{5}{32}$	1	$\frac{5}{8}$	$\frac{1}{2}$	$\frac{3}{32}$	$1\frac{7}{32}$	$\frac{3}{16}$	$1\frac{1}{16}$	$\frac{9}{64}$	$\frac{1}{8}$	$\frac{13}{32}$	$\frac{23}{32}$	$\frac{1}{4}$	$\frac{21}{32}$	0.499	0.6610	16	$\frac{3}{32}$ to $\frac{1}{4}$
1	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{1}{4}$	$\frac{7}{32}$	$1\frac{1}{8}$	$\frac{5}{8}$	$\frac{1}{2}$	$\frac{3}{32}$	$1\frac{7}{32}$	$\frac{3}{16}$	$1\frac{5}{16}$	$\frac{11}{64}$	$\frac{5}{32}$	$\frac{13}{32}$	$1\frac{5}{32}$	$\frac{5}{16}$	$\frac{7}{8}$	0.624	0.9110	16	$\frac{3}{32}$ to $\frac{1}{4}$
$1\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{16}$	$\frac{9}{32}$	$1\frac{1}{8}$	$\frac{13}{16}$	$\frac{1}{2}$	$\frac{3}{32}$	$1\frac{7}{32}$	$\frac{3}{16}$	$1\frac{5}{16}$	$\frac{13}{64}$	$\frac{5}{32}$	$\frac{13}{32}$	$1\frac{5}{32}$	$\frac{5}{16}$	$1\frac{1}{16}$	0.749	1.1615	12	$\frac{3}{4}$ to 1
$1\frac{1}{4}$	$\frac{13}{16}$	1	$\frac{7}{16}$	$\frac{3}{16}$	$\frac{13}{32}$	2	$1\frac{1}{16}$	$\frac{1}{4}$	$\frac{1}{16}$	$1\frac{3}{32}$	$\frac{7}{16}$	$1\frac{3}{32}$	$\frac{15}{64}$	$\frac{7}{32}$	1	$1\frac{1}{16}$	$\frac{5}{16}$	$1\frac{5}{16}$	0.999	1.4115	12	1 to $1\frac{1}{4}$
$2\frac{1}{2}$	$\frac{7}{8}$	$1\frac{1}{4}$	$\frac{9}{16}$	$\frac{1}{4}$	$\frac{17}{32}$	3	$1\frac{1}{8}$	$\frac{1}{4}$	$\frac{1}{8}$	$1\frac{11}{32}$	$\frac{7}{16}$	$2\frac{1}{16}$	$\frac{19}{64}$	$\frac{9}{32}$	1	$1\frac{1}{8}$	$\frac{5}{16}$	$2\frac{1}{4}$	1.4985	2.4115	12	$1\frac{1}{4}$ to 2
3	$\frac{7}{8}$	$1\frac{1}{2}$	$\frac{11}{16}$	$\frac{5}{16}$	$\frac{21}{32}$	$3\frac{1}{2}$	$1\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{8}$	$1\frac{15}{32}$	$\frac{11}{16}$	2	$\frac{21}{64}$	$\frac{5}{32}$	$2\frac{5}{16}$	$1\frac{7}{16}$	$\frac{5}{16}$	2	1.8735	2.9115	12	2 and over

Bushing for Boring Jig.

Lining bushings for boring jigs are made of machine steel, case-hardened and ground, and the loose bushings are often also made of machine steel. They may, however, be made with equal success from cast iron, which wears well, and has less tendency to stick to the steel bar. The bushings for boring jigs may be made with facilities for removal, similar to those described in the May, 1908, installment of this series. In Fig. 164 is shown a bushing having two pins driven into the head, to facilitate removal, and the pin *A* over which the half-round slot in the edge of the head fits, prevents the bushing from turning. Slots, as shown at *B* are sometimes provided to permit cutting tools to pass through.



Figs. 160-166. Facing Tools, Boring Heads, Boring Jig Bushings, and Universal Joints for Driving Boring Bars.

In places where it is impossible to put in bushings before the bar is put in, or over the end of the bar after it is put in, a bushing made in two halves can be used, as illustrated in Fig. 165. The writer has seen this kind of a bushing in use in the Pratt & Whitney Co.'s shops, where it probably was originated, and it worked very well. The two halves are held together by a wire passing through the head flanges at one side as indicated. A bushing of this type can be put right over the bar at any place, and pushed into the lining bushing.

Knuckle Joints.

When boring bars are provided with a standard taper shank, this may be put directly into the spindle of the machine, but in that case the jig must be lined up very accurately with the spindle, and this sometimes takes more time than is permissible. It is better to use knuckle or universal joints for connecting the live spindle with the boring bar. These are constructed as indicated in Fig. 166, and are made in different sizes, for the different sized bars for which they are used. The shank *A* fits into the machine spindle. The end of the knuckle joint *B* is provided with a hole *D* into which fits the end of the collet *C*, which, in turn, takes the shank of the boring bar. The hole *D* may also take the end of the boring bars directly. The method of driving the bar from the knuckle joint may be either by a taper pin as shown in Fig. 166, or by the means shown in the engraving in Table XII, where dimensions are given for a coupling of good construction, connecting boring bar and knuckle joint.

* * *

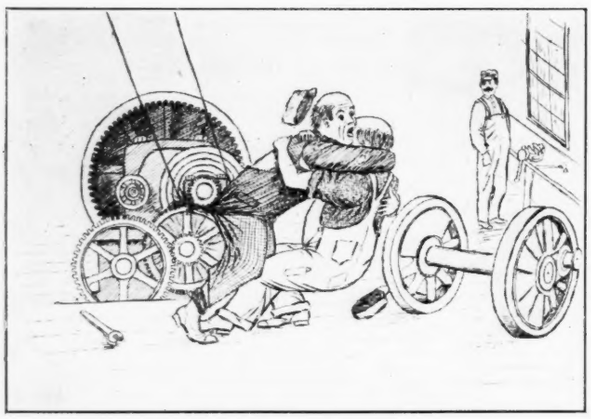
Constant improvements are being made in machines used for aerial navigation. Wilbur Wright, since the breaking of the driving chain of one of his propellers while in flight, has made an arrangement by which both propellers are connected by a chain so that if either of the driving chains should break both propellers will still continue to revolve, and there will be no danger of accident from the gyroscopic action. The superiority of the Wright brothers' machines is attributed by Sir Hiram Maxim, whose pioneer work in aeronautics has attracted wide attention, to the fact that the Wright machine uses two propellers turning in opposite directions, whereas Farman's and Delagrange's machines are equipped with a single propeller run at a very high speed. When these latter machines are turned sideways the gyroscopic action tends to make the machine turn over about a transverse axis. This accounts for the difficulties which these inventors have had in properly navigating in circles and curves. It is reported that the Russian government is negotiating with the Wright brothers for the purchase of some of their aeroplanes. The Russian government requires a three hours test flight, but the inventors consider this unnecessary, as a one-hour test flight would demonstrate the practicability of the machine equally well, provided sufficient fuel was carried for the machine to remain in the air for three hours.

SHOP SCRAPS.

PEACEMAKER.

"Scrap" is a very general and common term around the shop, but usually the sense in which it is used makes its meaning clear. Everyone familiar with shop work is more or less familiar with the shop "scrap," as it is commonly called, and can, no doubt, recall instances of such "monkey work," or may even remember of having themselves taken part in one of these star performances. It was, of course, the other fellow's fault, but it is poor business, at best, as experience has proven a great many times. The scrap habit is not prevalent in every shop, but there are some shops in which it is continually prevalent among a certain class of men, when the foreman's back is turned. This foolishness not only takes the time of the parties engaged in the scrap, but it distracts the attention of other workmen, and as a consequence much time is lost, which, as we know, is not to the advantage of the company.

Discipline in a shop usually depends as much on the man in charge as it does on the men themselves. It is not necessary for a foreman or superintendent to knock a man down with a piece of two-inch pipe in order to assert his authority, as I have seen done in a large tube mill. The best disciplined shop that I have ever seen, and in which a shop scrap of any kind was almost unknown, was one in which the "boss" made himself one of the boys, yet he had very little to say except on business. He never tried to appear in the least way above his workmen, and he had always the respect and admiration of every man and boy in the shop.



"Help! Help! Pull, Gus, pull!"

Although shop scraps are not at all necessary, we have them nevertheless, but they do not all come to and end so suddenly or in such Sunday-school story-book fashion as did a shop scrap which recently caused considerable amusement as well as a little excitement. Pat Hagerty, who ran the big driving-wheel lathe, never had much love for his shop neighbor, Gus Goodheinz, since the time he was accused of setting an alarm clock behind Gus when the latter had fallen asleep over his job on the boring-mill. If these men were on speaking terms at all, they were usually engaged in a wordy scrap whenever the foreman's back was turned, and this of course furnished much amusement for some of the boys in the immediate neighborhood. Occasionally Gus or Pat would get an apple core on the head, or possibly a rotten tomato in the back of the neck, which had no other effect than to make the surrounding air blue for a while and to renew the scrap with more vigor than ever. It happened that these scraps had never come to blows as it seemed that Providence had moved in a mysterious way His wonders to perform, and the foreman always put in an appearance just as the boys expected to see one or the other ready for the hospital.

Not only did Gus and Pat differ in opinion as to what a man's nationality should be, but they also disagreed on political matters. Although these men had not been on speaking terms for some time, each had been making sarcastic and slurring remarks within hearing of the other about the chief candidate he was supporting for the fall election. This of course caused considerable ill feeling, but nothing had been said strong enough to cause them to break their long spell of silence until the morning after election. The dark gray dawn of the morning after found Pat in an irritable mood, as he had lost the greater part of his night's sleep watching election returns only to see his hero defeated. On the other hand, Gus was in the best of spirits and was on the job fifteen minutes early with his overalls on, his sleeves rolled up and all ready for business. In order to avoid as much "kidding" as possible, Pat did not care to put in an appearance at the shop that morning until it was absolutely necessary, and entered the shop door just as the whistle blew. Neither looking to the right nor the left, he made a bee-line for his machine, and giving it a few hurried glances to see that things were all right, grabbed the starting lever and threw it over with a bang. Gus, who was standing nearby with a broad smile on his moon face, could hold in no longer. Calling across to Joe on the 10-foot planer, he shouted "Hey, Joe! It 'pears to me that it is about time some of these fellers around here were startin' on their journey up Salt River this mornin' after gettin' walloped the way they did yesterday."

This was too much for Pat, who, of course, overheard the remark. He looked about and the foreman was not in sight. Turning on Gus like a shot out of a gun, he "ripped" off some remarks that would not look well in print, and in an instant Gus's happy smile had faded. There was all indications of a lively scrap as he stepped over in front of Pat at the end of the latter's lathe, but Providence again seemed to interfere and in an instant Pat felt a tug at his rear, and before he realized what was going on, he was being pulled into the gears of his lathe. With a wild and desperate effort he threw his arms about his opponent's neck, and Gus waking up to the situation at the same time, threw his arms about Pat and began pulling like a bull-dog with a death grip, while Pat was yelling at the top of his voice, "Help! Help!! Pull, Gus, pull!!" After a frantic struggle Gus succeeded in pulling his victim from the tenacious grip of the gears in such a condition that he was hardly presentable to the large audience which was rapidly gathering to see what all the noise was about.

It is needless to say that this ended the scrap and that the boys gave Pat the laugh when they had learned the trouble and saw that he was not seriously hurt. Pat, with a sickly grin on his face, was backed up against a post for self-protection, and was so badly scared that he could hardly speak, while Gus in an excited and gesticulating manner was trying to tell the curious crowd how it all came about and how he saved his victim from an "awful death."

Pat was badly in need of a few "glad rags," and would probably have had the disgrace of going home in a barrel had it not been for kind-hearted Gus, who willingly consented to loan his unfortunate neighbor a pair of overalls which he happened to have in his tool-box.

The foreman who was on the scene shortly thought the whole thing a good joke, and when he explained the cause and effect to the superintendent he said he guessed their experience was reprimand enough, and a mild lecture would not only be unnecessary but would be entirely out of place after the practical lesson the boys had had.

That night after work, for the first time in a year, Gus and Pat walked home together. No one has yet learned what was said in the confidential talk that took place that evening, but Pat and Gus are now good friends, and every evening they are seen strolling peacefully home together.

* * *

An example of the effect of superheated steam on cast iron pipe fitting is mentioned in the *Engineering Record.* A twenty-inch tee recently removed from a main steam line in an electric railway plant in Baltimore, which had been in service three years carrying steam of 160 pounds pressure, with a superheat of about 500 degrees F., was found to have grown nearly three-fourths inch in length, and was fully one inch larger in diameter than when installed. The outer surface of the fitting was covered with fine cracks, some of which had opened up in places to one-eighth inch, and steam had begun to leak through the larger of these cracks.

METHOD OF MAKING MASTER TOOLS FOR EYELET SETS.

WARREN E. THOMPSON.*

The manufacture of tools or "sets" used in special machines called "eyeletters" for putting eyelets in shoes, corsets, pocketbooks, and other like products, is, in a way, a business in itself, as special machines and fixtures, as well as men who are specialists, are required. The method is one of the master tool methods of making forming tools and manufacturing tools that may be duplicated at any time. The processes described may be applied to the making of formed cutters by designing machines for the work embodying some of the principles shown.

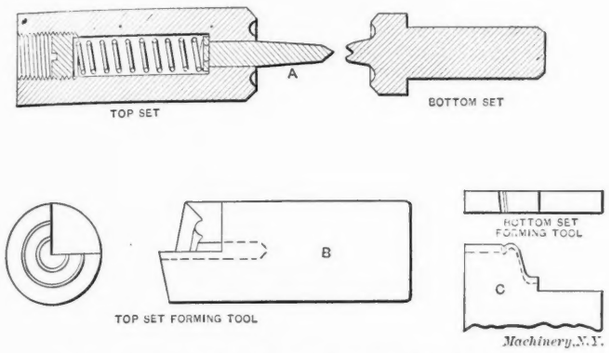


Fig. 1. Tools or Sets for Round Eyelets, and Forming Tools by which they are Formed.

Eyelets are made by special machinery in an endless variety of sizes and styles. The round eyelet is the most common and the oval is used to a much smaller extent, but enough to make it important as far as the manufacture of the tools is concerned.

Stock used for Sets.

Tool steel drill rod is used in most cases to make all sets except the oval bottom set; drill rod is used because it needs no sizing and stands severe usage. The oval bottom sets are made of both tool and low carbon steel; 35-point carbon steel, pack-hardened in new bone, is used to the largest ex-

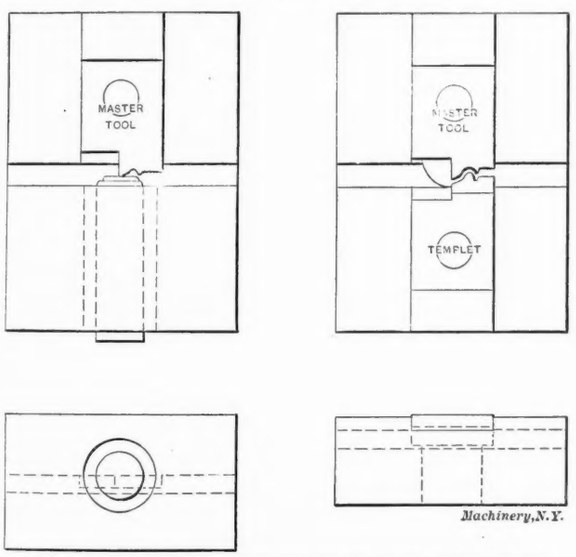


Fig. 2. Filing Jig for Templets and Master Tools, with Arbor for Holding the Eyelet. Fig. 3. Filing Jig for Master Tools.

tent, as the dies are not damaged or worn as fast as when using tool steel, and the sets thus made have given satisfaction wherever used. All stock is cut off and finished on the screw machine, ready to have the end formed.

Master Tools for Round Sets.

In Fig. 1, *A* is a section of a pair of sets for rolling the round eyelet. The top set is threaded at the back end to take a spring tension screw and to hold it in the machine. The pilot is made a few thousandths larger than the inside of the eyelet on its largest diameter; this enables it to take an eyelet from the raceway used on the eyeletter and hold it until the work is slipped into position. When the machine is in operation, the spring pilot is pushed back into the set and on the return leaves the work on the bottom set. Both sets must be made to conform to the eyelet used, and a slight change from the forms found correct will produce defective work.

Usually the tool-maker is furnished with a number of eyelets from which it is easy to select one that is perfect. This eyelet is mounted in an arbor as shown in Fig. 2. If necessary, beeswax may be used to hold it firmly in place, but in all cases the eyelet must be central with the arbor. This arbor fits a jig as shown, and its axis is exactly central with the slot or groove guiding the tool. The tool is then filed, as shown, to fit the head of the eyelet. This fit is made as close as possible, using a double eye glass to test with. The tool is then hardened and the face ground smooth, after which the form is stoned if necessary to a fine fit on the eyelet.

Often the top set for an eyelet is furnished to the tool-maker, and in this case a templet is made first. The same jig is used, and the templet made a perfect fit to the set. Templet stock of the same thickness as the tool stock should be kept at hand. It is milled away so as to leave only 1/32 inch to file.

The master tool for the bottom set is filed in a jig, Fig. 2, in the same way as the top set. The making of the first bottom

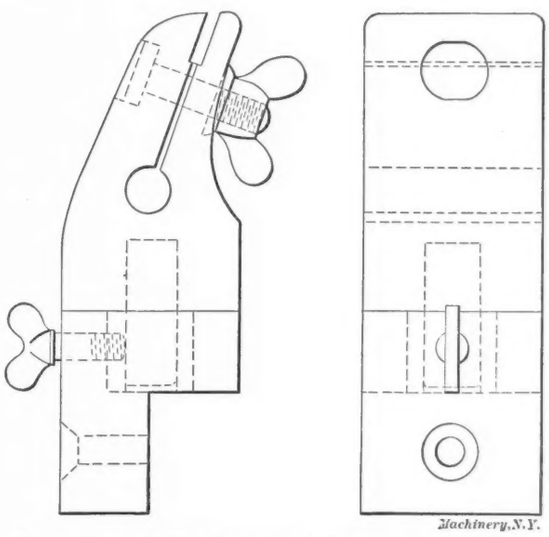


Fig. 4. Vise for Holding Templets and Master Tools when Filing.

set requires considerable experience. A blank is prepared and turned to what is judged to be about the correct form. It is then tested in a bench machine and the roll it makes on the eyelet is noted. The form is corrected until a perfect roll is obtained, and the master set is then hardened and polished.

In case a templet for the top set has been made, the jig shown in Fig. 3 is used to produce a master tool. This jig is simply a block of steel having two slots or grooves in line and in such relation to each other that the bottom of the top slot is about 0.005 inch below the face of a tool in the lower slot. The tool is filed and stoned to a perfect fit, and a tool having the same contour as the required set is thus produced. All tools are drilled in a plain jig with a standard hole.

The bench fixture or vise, Fig. 4, is provided for the convenience of the tool-maker when filing. It is made of hard wood and swivels in any position on a steel rod which is driven into the vise, and which rolls in a steel bushing having a thumb-screw for locking purposes.

Circular Forming Tools.

A top set forming tool is illustrated in Fig. 1, at *B*. The stock for these tools is first cut off and milled and a small hole drilled in the front end. The machine for making the tools is shown in Fig. 5. This machine consists of a cast

* Address: 39 High St., Lynn, Mass.

iron base planed and bored to take a tool slide and spindle. A spring-chuck with draw-bar is fitted into the spindle, and a cam is held to it by screws. This cam is held against its mate by the spring shown, and the hand wheel is keyed and held by a lock nut. The cam used has a rise of 5/32 inch.

The tool in the tool slide is quickly adjusted by loosening a lock nut, and is then slowly fed into the work by the feed screw. The tool set in position has its face in a line with the axis of the spindle, and hence produces a form exactly the same as that of the eyelet. The first circular tool produced with each master is used to produce another circular tool of the same contour as the master, and this circular master is then used to produce all manufacturing tools. A cam having a throw of 3/32 inch is used in the duplication of the master in another machine of the same type.

Flat Forming Tools.

On account of the teat on the bottom set and the consequent difficulties encountered in making circular tools, flat tools are used. These tools are planed in the machine illustrated by Fig. 6. This machine has a cast iron base planed and bored to take two tool slides and the spindle. The spindle carries two cams, one of which operates the planing head and the other the tool relief. The tool slots are in alignment and the stationary tool is moved by the feed screw. The ram has a uniform downward motion for three-quarters of a revolution, and the other quarter returns it to the starting point. The two cams are so arranged that the tools are separated just before the return and are in position again before the down-stroke commences. The tools have 20 degrees end clearance and 4 degrees side clearance and the slots are planed at these angles.

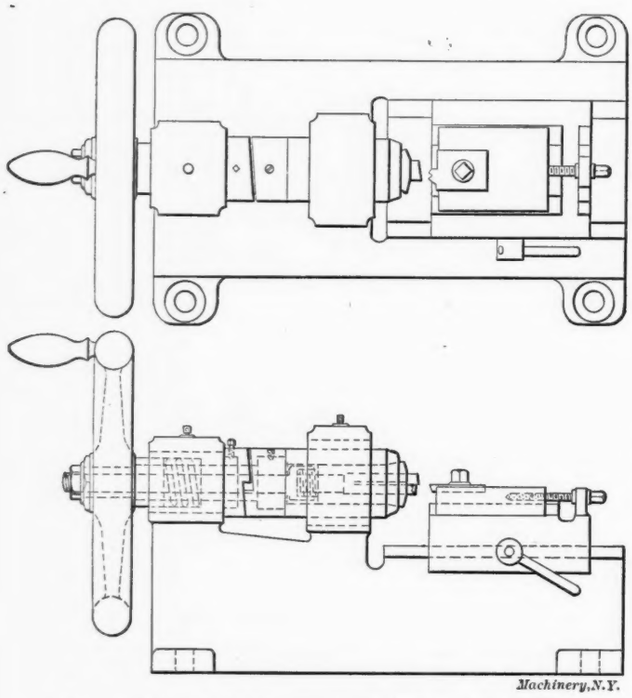


Fig. 5. Machine for Making Circular Tools Formed on the End.

The master tool previously fitted to the set is bolted to the ram, and a blank, roughed near to shape, bolted into the carrier. After the form is planed smooth all over, it is hardened and stoned. This tool is then used as a master for making the manufacturing tools, the first master being used but once, except in case of breakage.

The master tools should be kept in covered trays carefully separated, as the slightest nick or imperfection on the cutting edge destroys their value. The manufacturing tools are used in small bench lathes in special holders.

Oval Sets.

Oval sets, on account of their shape, are much more expensive to make than the round ones, and it requires considerable experience to construct the tools properly.

Oval top and bottom sets are shown in Fig. 7. As the oval eyelets do not break as evenly as the round eyelets when rolling, the bottom set has six or eight cutting edges in the form. These sets are stamped under a 100-pound drop hammer. The top sets have the form milled and the pilot hole broached.

The machine illustrated in Fig. 9 is used for making all of the plain oval forms in the top sets, trial bottom sets, "hubs," and other trial tools. It consists of a cast iron bed planed to take two slides, one for the cutter bushing carrier and the other for the work and feed mechanism. The work is driven by a worm and worm-wheel, and its position is regulated by a cam working on a roll set into the bed. This cam is held against the roll by a helical spring. The position of the cutter guiding bushing may be regulated by the set-screws shown, and its position determines the size of the oval form produced. The cutter is held in a drill press.

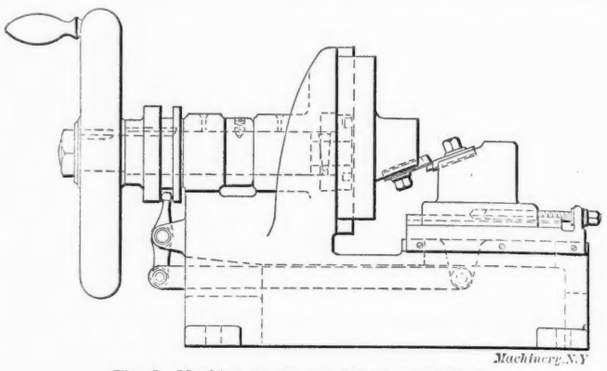


Fig. 6. Machine for Planing Flat Formed Tools.

Oval Master Dies.

A cam is first made of the same outline as the eyelet. This is placed in the machine and a cutter of about the correct form for the bottom set put in the drill press. A trial set is then milled and tested, using the device in Fig. 9. The cutter and setting of the bushing is corrected until a satisfactory set is produced. A piece of tool steel is now put in the machine and milled. It is of the same form as the trial set, and is hardened. This piece is called a "hub," and is used to produce a master form. The teat of the hub is made 1/16 inch longer than the set to provide clearance in the die. The ends of the stamped sets are finished after stamping.

The master form is made of 1¼ inch tool steel. This is held in a block by set-screws and the block is held in the stamp with the master blank aligned with the center of the "hub" holder. After setting, the master blank is heated to a good red heat on the formed end. It is then quickly clamped in a fixture and struck one good blow with the hub. This is usually sufficient to get a perfect impression, but in cases where it is not, the master has 1/64 inch turned from the face and is struck another blow cold. This impression must now be polished and the requisite number of grooves cut in it to form the splitting edges on the set. The divisions are made with dividers, as accurately as possible, and the cuts made with fine files. The master is then hardened and polished. Another hub is struck from this master and the manufacturing dies made from this hub.

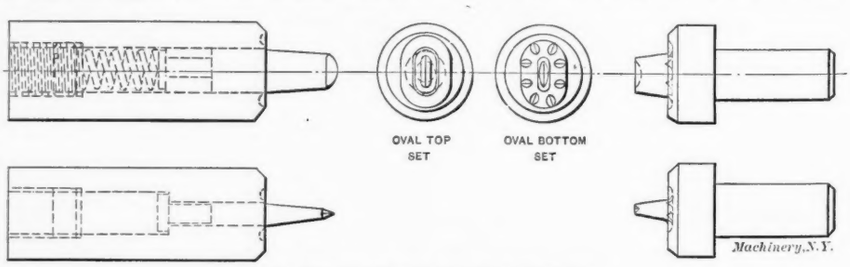


Fig. 7. Top and Bottom Set for Oval Eyelets.

The fixture shown at Fig. 10 is used in stamping the sets. The rack and pinion are made 8 pitch with a long hand lever for operating. The hole and counterbore are ground and afterward lapped large on the top end. The die is held in a cast iron body by large case-hardened taper pins. Plenty of oil is used when stamping as this prevents excessive sticking of the set after stamping.

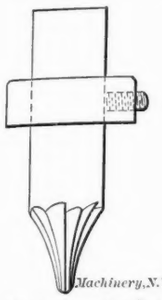


Fig. 8. Cover for Oval Eyelet Tools.

A cutter for use in making a hub is shown at Fig. 8. The cutter for blanks to go under the stamp is made nearly flat at the point.

Oval Top Sets.

The jig shown in Fig. 11 is used for making the oval pilot holes. The work is held between V-blocks, one of which is movable in the leaf and tightened on the work by a screw. Three bushings are used, one with an eccentric hole, one central, and one for the broaches. The holes are first drilled with the eccentric bushing guided by the keys in opposite slots in the bushing head. The center is then cut out with a small end mill using the concentric bushing. The hole is then broached with the broach shown, using oil. After the hole is finished, the groove is milled in the machine Fig. 9. The depth of the groove is governed by the collar on the cutter. The spring pilots are turned and milled close to size and file finished.

The sets, after hardening, are polished with a lap running at high speed, using fine emery. A templet is made for every correct cutter for purposes of duplication. All tools should be stamped with the necessary data regarding their use and purpose.

* * *

A painting by Max Lievermann pictures a group of peasant spinners at work and incidentally shows one of the great fundamental differences between a primitive people and American and other peoples that have risen to commanding positions in the industrial world. It appears that the type of spinning wheel shown requires two people to operate it—one to turn the wheel and the other to spin. Our American grandmothers were not so prodigal with labor, their wheels being so made that the spinner both drove the wheel and did the spinning. The uneconomical use of labor is a trait which distinguishes a primitive, unprogressive race from people who, through economical use of labor, increase and develop

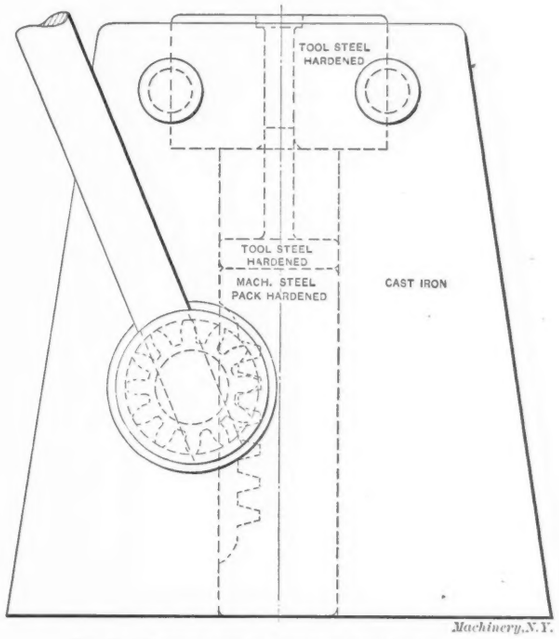


Fig. 10. Fixture used in Stamping Oval Bottom Sets.

productive capacity. If two persons are required to spin, it is only by unceasing labor for weeks that the family is able to produce clothing enough to clothe it for a year, because the other members must produce food to support the spinners while at work. The American spinning wheel, driven by one person, was only one step in the great advance that we have made in productive capacity. The prodigality of the primitive people in the employment of labor means everlasting poverty, while on the other hand, the increase of productive capacity through the development of modern machinery means that wealth is constantly accumulated, inasmuch as each worker produces much more than he consumes. In the primitive life the family is barely able to produce what the members require for a poor living, with all members of the family working who are able. Such a people will never develop a commerce of importance, neither will literature, art, or the other evidences of civilization become highly developed.

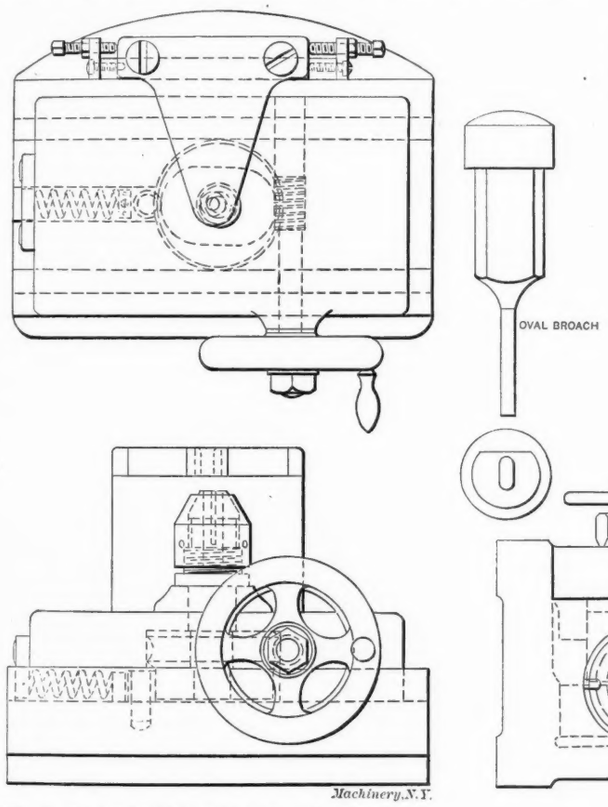


Fig. 9. Device for Making Plain Oval Top Set Forms.

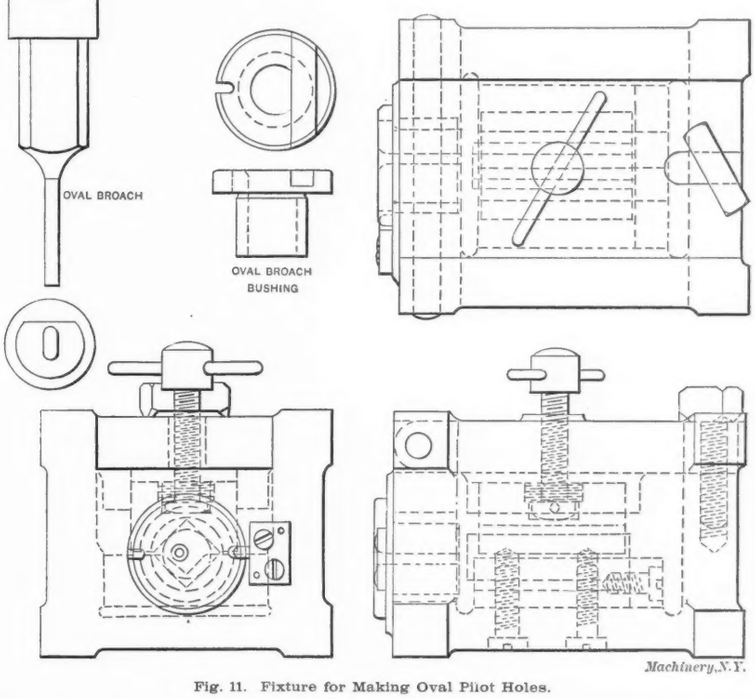


Fig. 11. Fixture for Making Oval Pilot Holes.

NOTES ON THE ECONOMICAL WORKING OF THE BLACKSMITH SHOP.*

JAMES CRAN.†

In selecting machinery for the blacksmith shop, a practical blacksmith who has had experience on the class of work for which the machines are intended, should be consulted, so that the equipment selected would be in proportion to the work to be done. It is not uncommon to find blacksmith shops equipped with hammers out of proportion to the work to be done, either too small or too large. In either case, it is evident that the working of the blacksmith shop is uneconomical. It is poor economy, in equipping a blacksmith shop, to provide it with too few steam hammers in proportion to the number of forges, as it requires the smiths to wait for their turn, and the time thus wasted will in the long run be worth a great deal more than the interest on the original investment

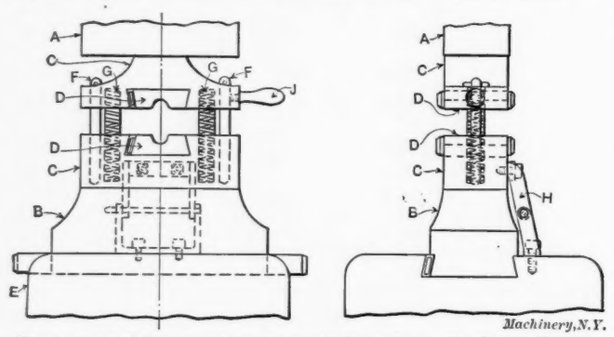


Fig. 1. Special Dies used for Economical Forging in the Steam Hammer.

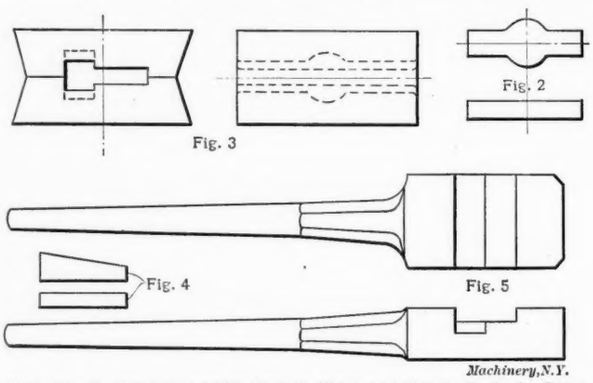
in one or more additional steam hammers. Not only is this waiting for the use of tools uneconomical in regard to the time wasted, but the steel is, in many cases, injured by having to wait too long in the fire after it is hot enough for working. If steel is thus left in the fire, it may get a pitty and rough appearance when the forging is completed, and in the case of tool steel, the surface will be decarbonized to a certain extent, and the tool will not give as good service when used for a cutting tool.

The economy of the blacksmith shop is also largely affected by the condition of the material supplied to the shop. If the blacksmith shop is supplied with material in long bars, these can be cut into the right lengths for the required forgings, and there will not be any waste, excepting, perhaps a small piece on the end of each bar. If, on the other hand, the material is supplied to the smith in short lengths or in odd pieces, there will most likely be a small portion of each of these pieces wasted, and weight for weight, a great deal more material will apparently be used for completing the same number of forgings, when using short stock than when using long bars.

It should not be forgotten that in most cases forging to shape is cheaper than machining to shape. Since high-speed steel became commonly used, the forging of spindles and similar work has been largely done away with, except in cases where large collars are formed on the spindle, for the reason that, using high-speed steel tools, the excess material can be removed so quickly that it is supposed to be simpler to turn these parts directly from the bar. However, even when using high-speed steel tools, it is seldom that work of this character can be machined from the bar as quickly and economically as it can be forged to the approximate shape, providing the blacksmith shop equipment is up to date. Not only is there a great deal of material wasted when turning off a large amount from the bar in order to form a shoulder or a collar, but the wear and tear on the machines where the work is performed and the time consumed outbalance, in many cases, the cost of rough-forging. Often a single blow from a steam hammer, when an inexpensive former or die is used, will do more to put the piece of iron or steel in the approximate shape required than could be done by an hour of machining.

If the blacksmith shop equipment is adapted to carrying out the forging of more or less complicated shapes, the scrap pile can generally be turned to good use, and considerable economy can be exercised in the use of new stock. Old pieces of machinery, which may be useless for the purpose for which they were originally made, may still contain good material, which can be used to make other forgings, of smaller dimensions, and may even save considerable work in the re-working as compared with the use of new stock. Lathe and planer tools, when too short for service, are quite often consigned to the scrap pile, when they could just as well be turned over to the blacksmith to be drawn down to smaller sizes and used for smaller work. Even the smallest sizes of tools, when worn down too short, can be drawn out and used in tool-holders or for boring bar cutters. Considering that high-speed steel costs anywhere from 60 to 80 cents a pound, and that a blacksmith can draw down to smaller sizes from 150 pounds to 300 pounds in a day, this would indicate a considerable saving in the steel tools. Of course, the scrap is always worth money, but the difference between the price of scrap and of new steel is too great to permit disregarding economy of this kind.

In order to help increase the efficiency, and to improve the quality and reduce the cost of work done in shops that are provided with only one steam hammer, the writer designed the steam hammer attachment shown in Fig. 1, which can be used for drop forging, swaging, forming collars, etc. This tool can also be fitted with shear jaws and used for cutting up material for forgings; or punches and dies can be fitted to it, and the tool used as a punch press. Being attached to the die chair of the hammer with jointed straps *H*, it can be used without removing the ordinary plain dies which can be used at any time by folding the attachment back in the open space between the hammer frame and the dies. This attachment can be used for all purposes that spring swages and other spring tools are used for, and will do superior work, because its being attached to the hammer prevents it from wobbling around while being used, as spring tools do. In making quantities of duplicate forgings, the attachment is a decided advantage over ordinary methods, both in the amount and quality of the work done. The blacksmiths' helper, not being required around the hammer to hold tools, can devote the most of his time to heating and handing the hot pieces to the smith. Should another smith want to use the hammer



Figs. 2 to 5. Examples of Blacksmith Work and Simple Tools for Same.

while the attachment is in position it can be folded back out of the way until he has worked his heat, and be placed in position again immediately after he has left the hammer. In the device shown, *A* represents the top die and *B* the lower die of the hammer. The parts *C* are holders for the dies *D*; *E* is the die chair, and at *F* are shown guide pins keeping the holders *C* in alignment. The springs *G* hold the dies open when no pressure is applied on the top, and *J* is a handle by which the attachment can be turned back out of the way when the plain dies are to be used.

The die holders *C* can be made either from steel castings or forged from machine steel. The lower dies *D* should be made from steel from 0.60 to 0.75 carbon and hardened. If the attachment is made so that the spiral springs *G* will keep the dies a couple of inches apart, a jet of compressed air or a small pipe connected with the air supply from the blower could be used to keep the impressions of the dies free from scale and would improve the appearance of the forgings.

* For previous articles on this subject, see "Welding," December, 1908, and articles there referred to.

† Address: 916 W. Third St., Plainfield, N. J.

Forgings of the style shown in Fig. 2 can be made in open dies, as shown in Fig. 3, which do not form any flash or fin, the only parts which need trimming being the ends of the forgings. The impressions are made wider than the forgings they are to shape, so that when a blow is struck by the hammer, the metal has room to spread. One impression shapes the forging edgewise, and the other brings it to the right thickness. When work of this kind is changed from one impression to the other at each alternate blow of the hammer, it can be completed in a very short time, and very close to size.

For forgings of the kind shown in Fig. 4 only one die or tool, as shown in Fig. 5, is necessary, the top die of the hammer being all that is required to form the top side of the forging.

The simple tools shown are used as examples to indicate how work can be done economically in the blacksmith shop. The economy of the blacksmith shop depends largely upon the tools and the general equipment, but, of course, it is also required that the tools be handled intelligently, and the economical working depends in the last instance upon the class of men employed. Any department in the shop, and not least the blacksmith shop, requires men who understand how to use the appliances furnished to the best advantage. It is a mistake to think that the cheapest help procurable is good enough for the blacksmith shop. On the contrary, the economical working of the blacksmith shop requires the very best class of men.

* * *

ARBORS FOR HOLDING WORK IN THE MILLING MACHINE.

A.

The arbors regularly used in milling machines for holding work between centers are invariably too long for certain classes of work, or in other words, they permit of too many pieces being held between the collar at one end and the nut on the other. The longer the arbor, the more it will spring when the nut on the end is tightened, and when under the pressure of the cut. No matter how true each separate piece placed on the arbor may be, if several of them are put together, they will invariably be "out of true," and the amount of "out of true" will increase with the number of pieces held. This spring in the arbors is very serious in some cases, especially when the pieces milled are to be finish-turned or ground after milling.

An example which may be cited is that of screw slotting cutters. The teeth are generally very fine and of very shallow

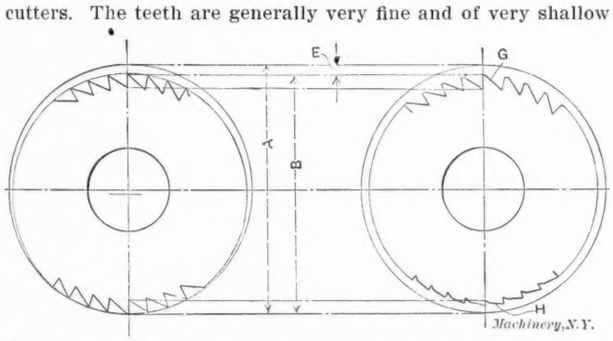
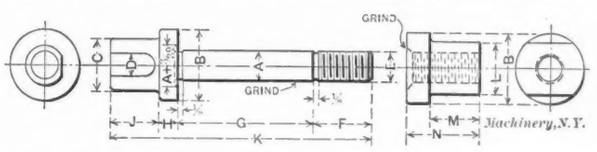


Fig. 1. Effect of Milling Screw Slotting Cutters on Arbors which are sprung out of true, owing to Excessive Length.

depth. Suppose that a number of these had been milled on an arbor which springs out of true when the cutters are tightened in place. When we now come to grind the outside of these cutters true with the hole, we will find that when the teeth are properly ground on one side, they are almost entirely ground away on the other side, or, in other words, the width of the land on the one side is out of all proportion to the width of the land on the other side, as shown exaggerated in Fig. 1. In this illustration the dimension *A* indicates the diameter of the blank, turned true before milling. *B* shows the condition of the cutter after having been milled on the arbor sprung out of true. As it is milled so that the top of the teeth present a sharp edge, the teeth will all appear of the same depth, but the cutter runs out of true a dimension equal to *E*. When grinding the cutter true with the hole after hardening, the lowest teeth are, of course, just cleared, as shown at *G*, getting the proper shape, but on the other side an amount equal to the amount that the saw runs out must be ground away, leaving hardly any teeth at all, as shown at *H*. The loss in diameter, equal to two times the amount *E*, which the cutter runs out in the first place, should also be noted.

In order to avoid the difficulties mentioned, arbors should be made rather short and stiff. The accompanying table gives well proportioned arbors for accurate work. These arbors may be considered too short, where work simply "good enough" is produced, but for the purpose for which they are intended, they will be found superior to arbors of ordinary length. On the other hand, the length has been made great enough, so as

TABLE OF ARBORS FOR HOLDING WORK IN THE MILLING MACHINE.



A	B	C	D	E	F	G	H	J	K	L	M	N
¼	⅜	11/16	¼	¼–24	⅛	1½	¼	⅜	3	9/16	¼	⅛
⅜	1	13/16	¼	⅜–20	⅛	1¾	¼	⅜	3½	⅝	¼	⅛
½	1⅛	1 1/16	¼	½–20	⅛	2	¼	⅜	3 15/16	⅝	¼	⅛
⅝	1¼	1 3/16	¼	⅝–12	⅛	2¼	¼	1	4½	1	¼	⅛
¾	1⅜	1 7/16	¼	¾–12	1	2½	⅜	1⅛	5⅛	1¼	¼	⅛
⅞	1½	1 9/16	¼	⅞–12	1⅛	3	⅜	1¼	6	1½	1	⅛
1	2	1 5/8	¼	1 –12	1¼	3	⅜	1⅜	6¼	1⅝	1⅛	⅛
1⅛	2¼	2	¼	1⅛–12	1¼	3½	⅜	1½	7¼	1⅞	1¼	⅛
1¼	2½	2	¼	1¼–12	1½	3½	⅜	1⅝	7¼	2	1⅜	⅛
1⅜	2¼	2⅛	¼	1⅜–10	1⅜	4	1	1¾	8⅛	2⅛	1	1¼
1½	2½	2⅛	¼	1½–10	1⅜	4	1	1⅜	8¼	2¼	1	1¼
1⅝	3	2⅛	1	1⅝–10	1⅜	4½	1⅛	1⅞	8⅞	2⅝	1	1¼
1¾	3	2½	1	1¾–10	1⅛	4½	1⅛	1⅞	9	2⅝	1⅛	1⅜
1⅞	3⅛	2½	1	1⅞–10	1½	5	1¼	2	9⅜	2⅝	1¼	1⅜
2	3⅛	2½	1	2 –10	1½	5	1¼	2	9¾	2⅝	1⅛	1⅜

to answer all reasonable practical manufacturing requirements. They are more especially designed for turning and milling screw slotting cutters. This will account for the large diameter of the collar, or shoulder *B*, at the end of the arbor, as well as the large diameter of the collar on the nut. These diameters are, of course, arbitrarily selected, and may be made to suit any requirements, but screw slotting cutters, being very thin, require all the support that can be provided sidewise. These arbors should be made of tool steel, hardened, and ground as indicated in the illustration accompanying the table. The nuts may be properly made of machine steel, case-hardened, and ground on the face coming next to the work.

* * *

In a consular report, Consul Albert Halstead of Birmingham, refers to the primitive methods of chain manufacture still in vogue in the so-called "black district" in England. The chains are forged by individuals in or at their own homes. Those engaged in the trade are not organized in any unions, but each works for himself individually. They purchase iron rods of the required size, from the iron merchants, bring them home on a wheelbarrow or carry them home on their shoulders; and on a little forge at the back of the house, the links of the chains are made from these rods. The forged chain is then carried, thrown across the shoulders, to the merchants, who pay for it by weight. The makers of the chains are entirely at the mercy of these middle-men merchants. The tools used in making the chain are not many. The chain is made wholly by hammer and without finishing tools. Of course, the chain is not high grade, the links vary in shape, the weld is apt to be imperfect, and the chain is not tested. Small-sized chain from 3/16 to 1 inch in diameter is made chiefly by women, girls and boys, and by old men whose vigor is so much lessened that they are unable to do the heavier work. The women working on chain making earn from thirty to forty per cent of what the men earn making the same sizes. In some cases, the percentage is as low as twenty-five per cent.

THE NEW YORK CENTRAL LINES APPRENTICESHIP SYSTEM.

It is gratifying to note that the leading railroads of the country have realized the necessity of apprentice systems in the railroad shops. The New York Central Lines have a well-organized system for educating apprentices, and in an address before the Pittsburg Railroad Club, the superintendent of the apprentice school of this road, Mr. C. W. Cross, gave an interesting account of the results obtained, and the effect of the training of apprentices in the company's shops.

The one most noticeable from the installation of the new apprentice system has been the increased efficiency of the apprentices. This is largely due to the addition of the shop instructor, although the benefit of the class-room work is also apparent. Under the old system the foreman was expected to see that the boys received proper instruction concerning their work, and that they performed it properly. Ordinarily the foreman is too busy to give the boy anything like the required amount of attention. With the addition of the shop instructor, who has the duty of looking after the boys, the efficiency of the apprentice has very greatly increased, with a resulting improvement both in the amount of output and the quality of the work done. There is no question but that the work accomplished by the shop instructors has more than paid for their salaries. The shop foremen, relieved of the care of the boys, can give their time to the more important details of the work. Reports from the ten shops where apprentice schools have been established show that in every case the boys are not only turning out a better grade of work than ever before, but that they are working on machines, or doing bench work, that formerly it was not thought possible to entrust to apprentice boys.

Another important advance is that the apprentice, after he has had a few months of class-room instruction, can read simple working drawings, and the third and fourth year apprentices are able to read the most difficult drawings. When one stops to consider the comparatively small number of so-called mechanics in the average railway shop who can read working drawings readily, and the necessity of being able to do this, its importance can be realized. Not only this, but the boys are able to make sketches, or drawings, of shop devices or of broken parts, which it is oftentimes advisable to have for record at the local shop or for transmission to the mechanical engineer's office. During the past year the apprentices of the New York Central Lines made 1,344 drawings, which have been placed in the files of the New York Central Lines drawing rooms for use and record.

The criticism may be made that this work will unfit the boys for remaining in the shop. A certain percentage of the boys will, of course, wish to be transferred to the drawing room, but anyone who is familiar with the difficulty of securing satisfactory draftsmen for a railroad drafting room, who have had the necessary shop experience to handle the work required of them to advantage, will realize that it is very desirable to have a few of the boys graduate from the shop to the drawing room.

It is often desirable to conduct tests of tools or devices, or to determine the efficiency of various kinds of machines or other apparatus. The training which the boys have received in the class room has enabled a number of them to be used to great advantage during the past year in assisting on or conducting such tests. The benefit to the apprentice and the company is mutual. Another effect of the new system is the better discipline over the boys and the effect which this has had on the shop as a whole. At several of the shops the boys have organized apprentice or debating clubs. It is the practice to prepare papers on different topics and to discuss them. The class-room training helps the boys to take part in these meetings and has been the means of developing them to a considerable extent.

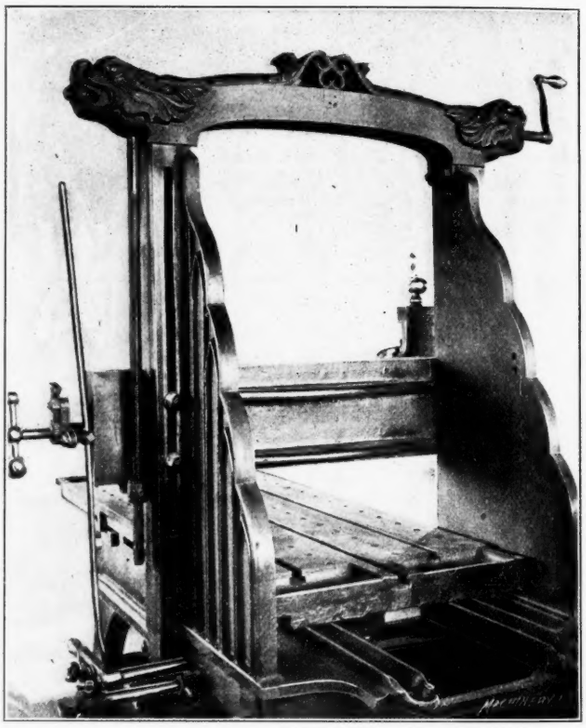
At several shops where it was formerly hard to obtain enough apprentices or to get a good grade of boys, little difficulty is now experienced, as the boys are assured of being given a thorough training in the trade and of having greater opportunities of advancement than formerly. It has been the practice for apprentices to occasionally make visits to neighboring shops of other roads or to some of the other shops on the system. Several of the boys obtained ideas which they put into use at once. One boy who was working on a boring mill changed to the method of fastening the tires on the table to correspond to the method he had seen at Schenectady. He did this without waiting for definite directions from the instructor, and soon found that he was able to gain one tire in his day's work. The impression made on the minds of the boys by observing the methods of experienced workmen prove much more lasting than when these same methods are explained ever so clearly by their instructors. It is a paying proposition to the company to allow either boys or men to visit other shops where work of a similar kind is being carried on. The boys, after the above-mentioned trips, were asked to write letters to the shop foreman as to their observations and what they had learned. These demonstrated the benefits which were gained.

* * *

PLANER WITH ELABORATE ORNAMENTATION.

H. P. FAIRFIELD.

Highly ornamented machinery has, of course, gone out of style, but at one time there must have been considerable rivalry between the builders of machines, as to who could get out the most artistic machine patterns. The accompanying illustration, which shows an old planer that has been in service since about 1855 and is yet a "planer," is an excellent



Example of Artistic Pattern Work as practiced in the Early Days of the Machine Tool Industry.

example of the vast amount of unnecessary artistic pattern work formerly done by some machine tool builders. As will be seen, the ornamentation of the sides of the housings is after the pointed or Gothic style of architecture, while the ends of the elaborately carved tie-piece across the top, represent gargoyles. This planer was built by the Thayer-Houghton Co. of Worcester, Mass., afterward the New York Engine Co.

* * *

The utilization of the water power available in Switzerland has now been placed under the direct supervision of the state, which will take the necessary steps to safe-guard the interests of the public. The transmission to foreign countries of power generated in Switzerland is subject to the approval of the state, and the royalties will be paid by private users of water power, to the Government. This development is one more step towards the recognition of the right of the whole people to natural resources exploited by private enterprise.

ITEMS OF MECHANICAL INTEREST.

INTERESTING FEATURES OF AN ELECTRIC COAL-PUNCHER.

One of the difficulties encountered in producing an electric coal-puncher, except in the solenoid types, has been in the conversion of the rotation of the motor into reciprocating motion for the drill. Where the blow is directly dependent on the motor, the latter gives trouble because it is not able to stand the vibrations and strains incident to the powerful blow of the pick, and if springs play an important part in obtaining this blow, there are other troubles because of breakage and unreliability. Types with separate motors and flexible shaft connections have also been tried in order to obviate some of these difficulties, but complications were introduced which at least partially off-set the benefits derived. A reciprocating drill or coal-puncher is made by the Pnuemelectric Machine Co., Syracuse, N. Y., which uses both compressed air and electricity. The latter is the actuating power and the compressed air gives the blow. As the connection between the driving motor and the striking pick is not a rigid one, the vibrations are cushioned. The mechanical means by which the rotation of the motor armature is changed to a reciprocating motion to drive the air compressing piston, and the way in which a single air cylinder, with practically no valves, compresses the air which impels the pick-carrying piston, will be explained in the following:

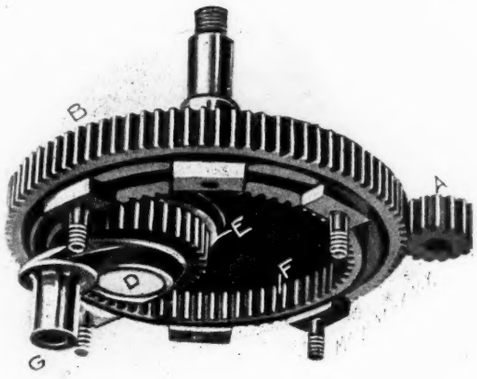


Fig. 1. General View of the Mechanism illustrated in Fig. 3.

The small pinion *A* (Fig. 1) is attached to the shaft of the motor armature, and engages the main driving gear *B*, which has a solid web carrying the stud *D*, which, in turn, carries a crank pinion *E* having 33 teeth. Internal gear *F*

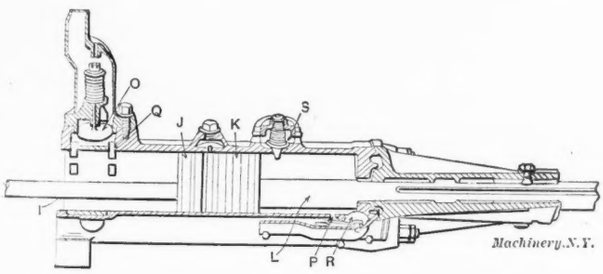


Fig. 2. Air Cylinder in which the Air is compressed and used to impel the Pick-carrying Piston.

(Figs. 1 and 3), which is rigidly fastened to the frame of the machine, is concentric with the main driving gear *B*, and the crank pinion *E* engages with this gear as shown in the illustrations. The pitch diameter of this crank pinion is just one-half that of the internal gear which has 66 teeth. The crank-pin *G* which is attached to the pinion *E* engages with the cross-head *H* to which the rear piston-rod *I* (see Figs. 2 and 3) is attached. When the main driving gear *B* is revolved by the armature pinion, the crank pinion stud *D* describes a circle in the direction indicated by the arrow, and the pinion *E* revolves on the stud and around the internal gear. When the pin *D* has moved one-quarter of a revolution, it will be in the position shown at *b*, and the pin *G*, attached to the cross-head *H*, will be in the center of the internal gear. At the completion of one-half a revolution, the pin *G* will have moved rectilinearly a distance equal to the pitch diameter of the internal gear and will be in the position shown at *c*. Similarly, at three-quarters of a revolution, the pin will be again in the center of the internal gear as shown at *d*, and at the completion of a full revolution, it will be at the point of starting as at *a*. In this way the crank pinion, as it revolves around the internal gear, gives the pin and attached cross-head *H* a rectilinear forward and backward movement.

The way in which the air is compressed and utilized to impel the pick-carrying piston forward, all in one cylinder, constitutes the most interesting and novel feature of the machine. Fig. 2 shows the cylinder, front head, and the two pistons and rods. The rear piston *J* is attached to the cross-head *H* in Fig. 3. The front piston *K* has no connection with *J*, but it is connected with the drill or pick socket by the rod *L*. The first stroke of the pick is purely mechanical. The rear piston *J* moves forward, pushing the front piston *K*. During this stroke, air is drawn into the cylinder behind the piston *J*, through the main inlet valve *O*. On the return stroke, this air is compressed and at the same time the front piston *K* is drawn back by the partial vacuum created by the piston *J*, air being admitted in front of *K* through a port *P*. When the return stroke is completed, the rear piston has passed the by-pass opening *Q* in the cylinder, which opening

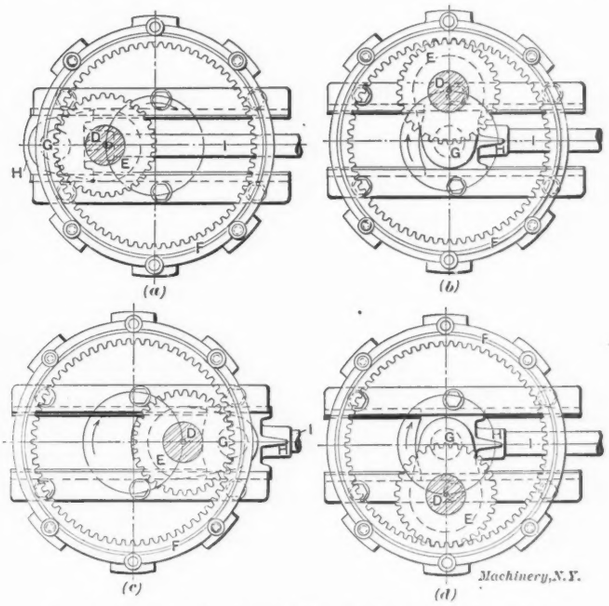


Fig. 3. Method of changing the Rotary Motion of the Motor to a Reciprocating Movement.

is between the two pistons at the time. This allows the compressed air to force the front piston forward, exactly as in any compressed air drill. In this way the first real stroke of the machine is made; that is, the mechanical stroke mentioned above is made only once or when starting from rest. On the forward stroke of the piston *K* the air in front escapes through the port *P*, but after the piston has passed and therefore closed this port, a sufficient amount of air remains to cushion the blow and prevent damage to the front cylinder head. This cushion air may leak somewhat, and to prevent an insufficient supply remaining which would have the effect of creating a partial vacuum in this space and holding the piston on the return stroke, a small inlet valve *R* is placed in the forward part of the cylinder. This allows air to flow in under these conditions before the open port is passed. When the front piston *K* has made its forward stroke, the rear piston follows, mechanically driven as before, and would compress the air which has just made the stroke of the front piston, were it not for the so-called vacuum valve *S*, which allows all air between the pistons above a certain pressure to escape to the atmosphere. The action of this prevents the two piston faces from coming together.

Copyright, 1909, by THE INDUSTRIAL PRESS.

Entered at the Post-Office in New York City as Second-Class Mail Matter.

MACHINERY

DESIGN—CONSTRUCTION—OPERATION.

PUBLISHED MONTHLY BY

THE INDUSTRIAL PRESS,

49-55 LAFAYETTE STREET, CORNER OF LEONARD,
NEW YORK CITY.

Alexander Luchars, President and Treasurer.
Matthew J. O'Neill, Secretary.

Fred E. Rogers, Editor.
Ralph E. Flanders, Erik Oberg, Franklin D. Jones, Ethan Viall,
Associate Editors.

The receipt of a subscription is acknowledged by sending the current number. Checks and money orders should be made to THE INDUSTRIAL PRESS. Money enclosed in letters is at the risk of the sender. Changes of address must reach us by the 15th to take effect on the following month; give old address as well as new. Single copies can be obtained through any newsdealer.

We solicit exclusive contributions from practical men on subjects pertaining to machine shop practice and machine design. All accepted matter is paid for at our regular space rates unless other terms are agreed on. All copy must reach us by the 5th of the month preceding publication.

MARCH, 1909.

PAID CIRCULATION FOR FEBRUARY, 1909, 21,037 COPIES.

MACHINERY is published in four editions. The practical work of the shop is thoroughly covered in the Shop Edition, $1.00 a year, which comprises approximately 650 reading pages and 36 Shop Operation Sheets, containing step-by-step illustrated directions for performing 36 different shop operations. The Engineering Edition—$2.00 a year, coated paper $2.50—contains all the matter in the Shop Edition, including Shop Operation Sheets, and about 250 pages a year of additional matter, which includes a review of mechanical literature, and forty-eight 6 x 9 data sheets filled with condensed data on machine design, engineering practice and shop work. The Foreign Edition, $3.00 a year, comprises the same matter as the Engineering. RAILWAY MACHINERY, $2.00 a year, is a special edition, including a variety of matter for railway shop work—same size as Engineering and same number of data sheets.

SOME DEFECTS IN OUR TARIFF REGULATIONS.

The practical workings of some of the tariff regulations applying to the return of American machinery to this country for repairs, and the importation of gages, samples and other parts which are of no value to the American manufacturer except for purposes of measurement and comparison, were brought out at the recent hearings before the Committee on Ways-and-Means.

The Gisholt Machine Co. of Madison, Wisconsin, in a communication to the committee, stated that it received from a foreign customer a number of gages which were to be used for testing the tools being made for him, on which he had placed a value of $450, doubtless for insurance purposes. These gages, of course, were of no value to the Gisholt Machine Co. and it refused to pay the $200 duty demanded by the Custom House, as there was no possibility of the amount being refunded when the gages were returned to the owner, and the Gisholt Co. preferred to take its chances on getting the standards correct from drawings furnished by the customer. Another well-known tool builder, in a letter to MACHINERY, calls attention to a Custom House regulation, of a peculiarly aggravating character, applying to the return of broken parts sent for repairs. Our correspondent states that if a machine is broken in transit abroad, and the buyer asks to have the part repaired, the American manufacturer cannot have the broken parts returned to him without paying 45 per cent duty on them, although they are necessarily a part of the original machine and are of no value until the repairs are made. Another manufacturer also calls attention to the custom of charging duty on gages and tools, referred to by the Gisholt Machine Co., stating that he was obliged to pay $25 on a reamer sent by a foreign customer for finishing certain holes to the required standard. The reamer was of no use to any one except the owner, as it could only be used for finishing certain holes on special machines to an odd shape and size, and, consequently, it was returned with the shipment.

In the general revision of the tariff which is now taking place, the attention of our law makers should be called to unnecessary and irritating regulations of this character, which serve no purpose except to delay and increase the cost of repairs and construction of machines for foreign shipment.

* * *

WHEN A TRUST MADE GOOD.

We have all been taught that the unwieldy organization and the enormous capitalization prevents the average trust from manufacturing as cheaply as can a concern having all its activities directed by one concentrated management. We are prone to believe that trusts are bad, and that their capitalization of wind and water places a burden on labor and on the public out of all proportion to the benefits derived. Granted that these statements are true, in general, there is nevertheless another side to the shield, surprising in aspect in one case at least.

Some years ago an important manufacturing industry was "trustified," with the exception of one large concern having an annual productive capacity nearly equal to all the plants that went into the trust. The capitalization of the latter consisted of the usual amount of water, while that of its competitor represented actual values. For a number of years both the trust and the independent concern did a big business, but the common belief was that the trust would not make as good a showing as the single plant when hard times came. The independent plant is highly concentrated and organized in an old-fashioned way, while the trust comprises a large number of individual plants scattered over the eastern part of the United States; the equipment of many of which *was* very indifferent. However, the men responsible for results early in the game began a reorganization which utilized the great improvements in machine tools, methods, and steels, that have been developed in recent years; and the trust is producing machines today with a labor cost of approximately two-thirds that of the independent concern, being able to build machines for $1,000 apiece less than its competitor, and still make a good profit.

It is needless to say that the independent company referred to is a horrible example of misapplied methods. New machines, new steels, handling appliances, etc., are used; but the plant as a whole has not been reorganized systematically, nor the advanced modern methods made an integral part thereof. Present day improvements have been grafted onto old methods in a way that has resulted in no marked increase of productive capacity per unit of labor employed, and the modern engineering ideas which have been usually so potent a force in cost reduction have not been advantageously employed by the independent concern.

This seems to be a case where the necessity for earning dividends on watered stock has resulted in reducing the cost of a product to the user; but it should be understood that the machines referred to are not protected by patents and that the industry is one that cannot be monopolized.

* * *

As has been previously stated in these columns, the new British Patents Act requires that all patents granted in Great Britain be worked in that country. If they are not worked in Great Britain, the patents may be revoked upon application of parties who would themselves enter upon the manufacturing of the patented products. Ten applications for revocation of patents have so far been filed with the Patent Office, and two revocations have already resulted. These, of course, are subject to appeal before the courts. It appears that a great many manufacturers of patented articles both in the United States and on the European continent do not intend to manufacture their goods in the United Kingdom, but will depend upon their manufacturing facilities in the home countries to make it possible for them to compete with English manufacturers who would eventually take up the manufacture of their goods in Great Britain. Except in some special instances, it is evident that the British manufacturer who undertakes to manufacture foreign patented articles would place himself in an untenable position, because he would have to depend upon the British home market entirely for his sales; it would not be possible for him to obtain any foreign markets as long as the article is patented in other countries.

A CHANGE IN RED TAPE DESIRABLE.

Our reference last month to the lack of mechanical experience which frequently impairs the purchasing agent's value, is emphasized by a recent letter from a mechanic employed in one of the government departments, in which he speaks in strong terms of the difficulty of turning out work with the files supplied by Uncle Sam, which he says are "crooked, warped, not cut to edges, corners or ends. They glaze over, and in many cases are re-cut files, some of them having broken tangs. No doubt they are files rejected by the maker's inspector, but are good enough to unload on Uncle Sam."

A certain amount of departmental red tap is always necessary in connection with government purchases; but why not let it be applied by the operating instead of the purchasing department, in the case of small tools as well as large ones? If all bids for small tools were accompanied by samples to be tested, and the contracts awarded with due regard to quality as well as price, the government would undoubtedly be the gainer, and the industry represented would be benefited instead of being injured by the award of contracts to the lowest bidder for the lowest quality of goods; for that is what it virtually amounts to in many cases when the purchasing agent has absolute control.

* * *

A PROFIT SHARING EXPERIMENT.

In the December number, engineering edition, we referred to the interesting offer to employes of the Middletown Shipbuilding Yard, England, made by Sir Christopher Furness of that company. The company sustained heavy losses during the past year, largely due to labor troubles, and Sir Christopher offered the men preferred stock, payable in installments of 5 per cent of their wages, to be deducted weekly; these shares carrying a fixed interest rate of 4 per cent, and to participate equally with the common stock in a pro rata distribution of any surplus profits over 5 per cent for the common. The various trade unions concerned have agreed to the arrangement, which is to be given a year's trial before final determination.

This proposition has been described as a profit sharing scheme, which is hardly accurate. The men pay full value for their stock, in weekly installments, receiving only 4 per cent on their investment until, as stated, the regular stockholders are paid 5 per cent. As a matter of fact, they share in the profits as the investors or shareholders in any company share in its dividends. Nevertheless, this arrangement will benefit the men indirectly, as it benefits the firm directly. Each employe will now have a stockholder's interest in the welfare of the enterprise with his desire for profits undiminished by losses incurred in labor disputes. This should ensure peace to the company and greater permanency of employment to its employes; and the habit of saving to which the men are committed under this arrangement will be of permanent benefit to a great many, who will learn, perhaps for the first time, that a small amount regularly laid by provides in due time a substantial savings account. The exercise of self-control and self-denial, the building up of character, the cultivation of thrifty habits in the individual are possibilities of the greatest importance inherent in this English experiment. It is necessary to regard the proposition from this point of view in order to appreciate it, for as a case of actual sharing in the profits resulting from their own productiveness, the proposition is rather weak from the standpoint of the worker.

* * *

THAT INDUSTRIAL DEMOCRACY.

Referring to the editorial in the January issue of MACHINERY, entitled "An Industrial Democracy," the writer feels prompted to say that not everyone who has studied industrial conditions in Germany agrees with Captain Carden as to the competition of Germany with America in the manufacture of machine tools. "The man behind the gun" is not here. Both general and industrial education here, compared with that in America, bear the same relation to each other that the savage's ceremonial suit of a silk hat and a breechclout does to a "derby" and a plain business suit. The superior education of the employers and managers is here; but the workman is repressed industrially and socially; he has no inducement, no opportunity to come forward. Few or none start at the ash-pit and reach the manager's office.

The writer's first visit to Germany was in 1878-9; and since then, while the percentage of improvement in methods and finish is greater here than in America, because the basis of calculation is smaller, the actual progress in America is much greater; and at the present percentage rate of progress in the two cases it will take more than one generation before the two nations come together. Since January, 1894, the writer has lived, with the exception of one year in America and one in France, continuously in Germany; and has been uninterruptedly in communication with German engineers and manufacturers; has visited considerably more shops than the average American has, reorganized some, and ordered work from several; to say nothing of countless orders from individual workmen:—carpenters, locksmiths, model makers, blacksmiths, tinsmiths, plumbers, masons, etc. With the exception of about twenty shops, where the work is done on American machines, or on German imitations or modifications thereof, the German establishment is not on a level with ours in design or execution. In many of these twenty there are American or English foremen, or German foremen instructed by them. In one of the three very best German shops the leading spirit spent months in an American shop and brought back American machines as models. The work is now good enough, and original enough, for anybody; but after bringing over one special American machine he was obliged to send over for the foremen of the Philadelphia shop that built it, before he could make it work, after which he built others like it. What is considered the model German machine shop in amount, range, and quality of work, was built after an expert had visited over sixty American shops and culled the best features from each; and at first it had seven American foremen.

As regards the average German workman who is not a machine-tender—he has too many thumbs. The writer has never seen so much inexact work as is turned out by him. Captain Carden evidently never stepped into a German hardware store and compared, piece by piece, American and German tools, locks, etc.

Where Germany has the advantage of America is, among other points: 1. In low wages. 2. In granting long time on sales. Try to sell a machine tool in Germany under three months, in Austria under six, in Russia under twelve, and see "where you are at." Germans do it on the long-time basis. 3. In government ownership of railways, etc., shutting out American and other foreign competition in the matter of locomotives, cars, rails, etc. 4. In the difference of the banking institutions. Here the banks, as such, are directly stock-holders in machine shops, and indirectly interested in other manufacturing establishments; so that the latter get good credits from the banks, conditional on their buying their machinery, etc., from the bank-owned shops. These banks have branches in foreign countries, making collections more sure, and also discounting notes on condition of purchases being made where they indicate. 5. In short hauls of freight. 6. In an immense fleet of merchant vessels, sailing directly to all important foreign ports. 7. In reduced railway freights on exported goods. 8. In the love of work, as such, inherent in the German. 9. In the knowledge and use of foreign languages and business methods, enabling direct dealing with many nations. 10. In the willingness to make what the customer demands, instead of what the manufacturer thinks he ought to call for. 11. In the use of the metric system, enabling him to work in the standards of a great part of his customers, without extra trouble and expense. 12. In the neglect of Americans to patent their inventions in Germany. The writer has been offered, for example, "Trimo" wrenches bearing either the name of the German manufacturer, or the customer's, or the American trade-mark. Further willingness to oblige would be superfluous. 13. In packing goods decently for export. 14. In the absolute necessity to get trade abroad. The German is in the condition of the boy who was digging in a bank for a gopher. "Think you'll get him?" asked a passer-by. "Git 'im? Bound to git 'im. We're out o' meat!"

X.

NOTES AND COMMENT.

A consular report from Germany states that the Siemens-Schuckert Electrical Company contemplates the erection of a separate plant for the manufacturing of airships and aeroplanes.

It has been stated officially by President McCrea that the Manhattan terminal of the Pennsylvania Railroad will be able to handle traffic by May 1, 1909, and that one thousand trains a day will then be taken care of. The tubes under the rivers are practically finished with the exception of track-laying.

According to a German source the number of locomotives provided with superheaters in October, 1908, was 3,455. The Prussian State railways lead in the use of superheated steam locomotives, there being 1,789 locomotives of this type in use or in process of construction on the Prussian government railroads.

One of the speakers at the recent Conference on Natural Resources stated that the total power at present produced by prime movers in the United States is nearly 30,000,000 horse-power, of which 26,000,000 horse-power is produced by steam engines, 3,000,000 horse-power by water motors, and 800,000 horse-power by gas and oil engines.

The subway and elevated lines of the Interborough Rapid Transit Co., New York City, on Monday, December 21, carried 1,800,000 passengers, which is about 200,000 more than the maximum number for a single day last year. There was a slight diminution in the traffic on the Elevated lines for 1908, but in the Subway the volume of traffic increased 30 per cent.

A section 6,110 feet long of Boston's subway system was opened November 23. This section together with that previously constructed makes a total of 20,196 feet or nearly four miles. The section just completed cost $10,000,000 with its approaches and equipment, and has been leased to the Boston Elevated Railway Co. for a term of twenty-five years.

In a report made by Senator Flint of California to the National Conservation Commission it was stated that half the natural gas now coming out of the earth, equal to about 1,000,000,000 cubic feet per day, or more than enough to light all the cities of the United States having more than 100,000 population, is wasted by being allowed to escape into the atmosphere.

Prof. Charnock in a lecture, "Invention as a Science," delivered before the Bradford Technical College, England, called attention to the interesting difference between men and animals as regards mechanical instinct. Animals have no rotative movement, the very essential for mechanism. The fact that man can turn a crank and thus produce a rotary motion may be one reason for his ability to conceive and build mechanism.

The report of the Bureau of Railway Statistics states that the gross earnings for the fiscal year ending June 30, 1908, decreased $139,000,000. The gross earnings were $2,450,000,000 or $10,652 per mile, as against $11,383 a mile for the previous year. The operating expenses for 1908 will approximate $1,729,000,000 which is about $20,000,000 below those of 1907, so that the official returns for the year show a loss of $120,000,000 in net earnings, as compared with 1907.

The number of patents applied for in Great Britain decreased somewhat during 1908, as compared with the figures for 1907. This is ascribed to the fact that the new British Patent Act has discouraged foreign inventors from patenting their inventions in Great Britain, if they be not in a position to manufacture in that country. Of the patents issued, 1,100 relate to gas engines, between 800 and 900 to bicycles, 800 to the automobile industries, and 350 to aerial navigation. The total number of inventors was 3,586, of which 40 were women. It is a curious fact that a patent obtained by a woman, related to the cyanide process of treating ores, and apparatus for this purpose.

A subway system for transporting the mails between the various post-offices is to be established in Berlin. Two lines are projected, one of which will form a belt line in the central part of the city and will connect the main post-offices with the principal railroad stations. The second line will run between the various offices. The subways will be of small section, only 6 feet wide and 3 feet high, double tracked, the traffic being maintained by small electric cars run by an automatic system without a motorman. Between the two tracks in the subway there will be a depression which will serve as a foot-path for those who need to pass through the tunnel for inspection and repair purposes. The speed of the cars will be twenty-five miles an hour.

The galvanized wire suspender ropes which are to support the main span of the new Manhattan bridge, were recently tested under the direction of the bridge department of the city of New York at the works of John A. Roebling's Sons Co., where these ropes were made. The suspended span will be attached to the ropes, which are 1¾ inch in diameter, by means of steel castings socketed to the rope ends and threaded on the outside for 5¼ inch nuts. Three pieces of the rope were broken during the test, and in each instance the socket proved stronger than the ropes, which broke at 287,000, 288,600, and 290,000 pounds respectively. The greatest load to which one of the suspender ropes can be subjected is 50,000 pounds, so there is a factor of safety of over 5 for the suspenders and sockets.

In more than one instance in American railroad history can be found records of fatal wrecks caused by the burning of a bridge in a wild or lonely district where such a conflagration would rarely be discovered in time. The Canadian Pacific Railroad has provided against the possibility of such accidents by the adoption of automatic alarms designed to stop trains in case a bridge should burn. Semaphore signals are fixed about 3,500 feet from the bridges, each way, and at each signal is attached a wire which runs to a pulley on the bridge. These wires are connected with a rope which extends beneath the bridge for its entire length. The semaphore arms are heavily weighted so that if the rope should part, as would be the case if the bridge should burn or be destroyed by a flood, the signals would fly to the danger position.

The development of the underground rapid transit system of London has been very rapid. There is in that city, at the present time, eightly miles of subway built like the rapid transit system in New York, just below the street surface, and in addition to this, there is about one hundred miles of underground tube railways which are built at a depth of from 50 to 180 feet under the surface. During the rush hours, trains are run in some of these underground railways at an interval of a minute and a half; in the New York subway, due to the fact of impractical construction of the cars, it is not possible to run trains at closer intervals than about two minutes. As regards the handling of the passenger traffic with rapidity on both urban and regular railroads, there is no question but that England sets a pace well worth following.

A bulletin on comparative tests of briquetted and ordinary coal on locomotives has recently been issued by the Technologic Branch of the United States Geological Survey. The results of the test are summarized in the following conclusions: The evaporation per pound of fuel is greater for briquetted coal than for the same coal in its natural state; the capacity of the boiler is increased by the use of briquetted coal; briquettes have little effect in reducing the quantity of cinders and sparks, but the calorific value of these is not as high in the briquettes as in the natural fuel; the density of smoke is much less than with natural coal; the expense of briquetting, under the conditions of the experiments, added about $1 per ton to the present price of the fuel, an amount which does not seem to be warranted by the resulting increase in evaporative efficiency. In terminals, however, the briquettes can be used to considerably decrease the amount of smoke.

The Forest Service of the United States Department of Agriculture has of late issued several statements regarding the waste of our lumber resources, and it has appeared from many of them as if the lumber supply of the country could not possibly be expected in the future to meet the demand. Recently, however, a report has been issued on the present condition of the country's forest resources which indicates that, under proper management, our forests may be made to yield all the lumber required in our industries and trades, and that still the forests cover one-fourth of the area of the whole country. Methods of saving, which are, in particular, emphasized are the reduction of waste in the woods during lumbering, and in the mills, preventative treatment of wood exposed to water and dampness, steps for preventing forest fires, and especially proper legislative enactments, looking towards continual replanting of the forests.

In a recent issue of the *Iron Trade Review*, some applications of vanadium steel are indicated. It is stated that locomotive springs have been made from this material with excellent results. In ship-building work, the duty of the riveting dies of pneumatic hammers is very severe, and the average life of such dies is only about ten hours. Expensive brands of steel were tried by the New York Ship Building Co., but the results were not satisfactory until vanadium steel was used. The first cost of this steel was not only less, but it is inferred from the article mentioned that the dies can be used for months without breakage. It is also mentioned that in the yards of the same company, three hundred sleeves entering in the design of certain pneumatic machines had been broken in two or three months. In March, 1908, vanadium steel sleeves were adopted, and no breakages have since occurred.

In the *Zentralblatt der Bauverwaltung* an interesting reference is made to the wear of bridge pins. An early German pin-connected railway bridge, built in 1863, was taken apart recently for the purpose of replacing it with a bridge of larger capacity. The bridge was of the Pratt truss construction, 102-foot span, and 12 feet 7 inches depth of truss at center. The pins were two inches in diameter and made of carbon steel. They were measured at the center of the seat in the chord eye-bars, and the wear was found to be surprisingly small; only three pins in the entire bridge showed greater wear than 0.004 inch, and in the three cases where the wear was greater than this, it did not exceed 0.040. This is a good indication of the permanency of a steel bridge properly designed and erected and constructed of good material. Being still in good shape, this bridge will be re-erected as a footbridge.

The Cunard liner *Mauretania* has recently undergone extensive repairs, and the propellers have been re-arranged, so that it is expected to be able to increase the speed at least one-half knot, and at the same time reduce the vibration of the vessel. The change consists in fitting four-bladed solid propellers, each weighing 18 tons, to the two forward shafts, while the propellers on the two after shafts still retain three blades. What it means to overhaul a large ocean vessel may perhaps be best understood by reference to the fact that the *Mauretania* was in dry dock for about nine weeks, during which time nearly 2,000 men were employed in the work of overhauling and repairing the ship. The damaged shaft, which was broken some time ago during a trip across the ocean, has been renewed, and the forward port bracket—a forging weighing twenty-six tons—has been replaced. It is stated that the cost of this work amounted to $250,000, a rather large sum considering that the vessel is practically only one year old.

It is stated in the *Scientific American* that the question of supplying ties for American railroads has become so serious that the Santa Fé system recently sent its manager of the timber and tie department to Europe and the Orient to make a study of conditions. Among other things learned during this trip of investigation, was the fact that the Japanese government began to conserve its forests three hundred years ago, and that as a result of this foresight, Japan is now in a position to sell ties to railroads in this country. There is a duty of 20 per cent of the value on ties imported to the United States. The working of the higher political mind is certainly wonderful; on the one hand there is an outcry about the excessive use of our forests, and on the other hand, an attempt is made to prevent the importation of lumber from other countries by a restrictive tariff, although such importation undoubtedly would tend to save some of the timber supply in this country.

At the structural shops of Milliken Bros., Inc., on Staten Island, New York City, in the latter part of December, 1908, 143 tons of plates were punched in one day (8 hours, 47 minutes) on one machine. The plates were 13-inch flange plates for girders, 5/8 inch and 11/16 inch thick, and averaged about 32 feet in length. The average number of 15/16-inch holes was about 96 to each plate, staggered except at the ends. There were three sizes of plates and varieties of spacing; 52 of one kind, 168 of the second and 96 of the third. The total length of plate handled was 10,036 feet; weight 285,850 pounds, and total number of holes 30,384. This work was done on a multiple punch, four plates being passed through at a time. A few days previous to this, one man punched 12,740 9/16-inch holes, one at a time, in 10 hours. This was on light transmission line tower angles, on a light single stroke, quick-acting punch. These performances are believed to be records in the line of rapid punching in the bridge shop.

"There are other ways of killing a cat besides choking it to death with butter," and the conventional drill press and twist drill of the machine shop are not the only "pebbles on the beach" when it comes to the matter of putting a hole through iron. The Western plainsman uses his Winchester to perforate the wagon tire for a new bolt hole, and the blacksmith heats it and drives a punch through with three or four vigorous blows with his hammer. The boiler-maker scorns a ratchet and drill when he needs to set a stud in a boiler shell—if he is in a hurry. A hammer, cape chisel and drift in his hands are made to perforate a 3/8-inch shell and produce a smooth round hole in the time that a machinist would take to set up an "old man" and ratchet drill. The up-to-date engineer might use the oxy-acetylene torch if he had to perforate an armor plate quickly and without annealing. There are other ways too but none perhaps quite as novel as that proposed in the *Youth's Companion*: "Shape a stick of sulphur to the required dimensions of the hole, then heat the iron white-hot at the place where it is to be bored, and press the sulphur against it: sulphuret of iron is formed, and the stick passes through the metal."

Several times we have alluded in this column to the importance of the moving picture industry in America and Europe. Not only is it important as an amusement enterprise but it is acquiring much educational value and undoubtedly will become a very useful factor for improving industrial education as well as imparting general knowledge of processes difficult to describe without the visual expression. As a matter of amusement, for example, the people in Northern cities are acquainted with the life and local color of Southern cities, and *vice versa*. One series of pictures shown to a Northern audience recently illustrates the gathering, preparation and marketing of cotton. The field hands are shown on the scene gathering the snowy white product from the dark green plants. Then follows the loading of the cotton onto wagons, its transfer to the cotton gins and pressing into bales. From the gin the transfer to the wharves and loading into steamers follows, and then the scene changes to the cotton mill, the picking, carding, spinning, winding and weaving machines being illustrated in full operation. Thus in an interval of, say, fifteen minutes, an audience of ordinary individuals is shown as much and is taught as much of the cotton industry as an individual might acquire in a week or two of traveling—and all for the sum of five cents.

MODERN SWEDISH MACHINE TOOLS.

OSKAR KYLIN.*

In the writer's letter from Sweden in the September, 1908, issue of MACHINERY, reference was made to some of the more prominent Swedish machine tool works, and a general review given of the present state of the machine tool industry in that country. It is the writer's intention in the present article to describe and show a few representative types of modern Swedish machine tool design.

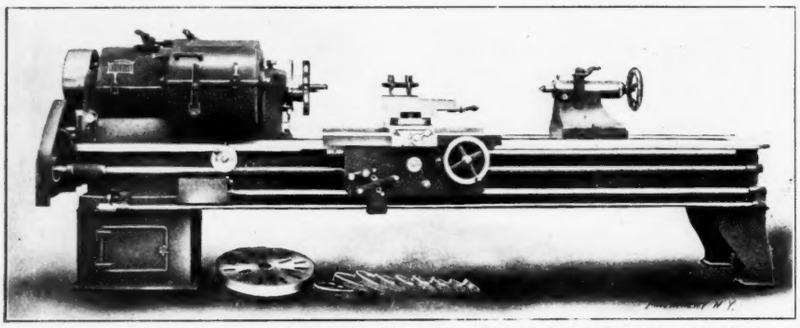


Fig. 1. Geared-head Lathe built by Lidkopings Mekaniska Verkstad, Lidkoping, Sweden.

Figs. 1, 2, and 4 illustrate machines designed and manufactured by Aktiebolaget Lidköpings Mekaniska Verkstad, Lidkoping. This firm has been established for more than thirty years, but did not take up the building of machine tools until about ten years ago; at the present time, however, the works specialize on a general line of machine tools, lathes being the most prominent feature.

In Fig. 1 is shown a twenty-four-inch geared-head lathe manufactured by this company. The design is along powerful lines, in order to permit advantage to be taken of the full capacity of high-speed steel. The single pulley geared head-stock is designed with twelve spindle speeds, the largest change gears being placed on the front side in order to obtain a steady drive. The bed is made according to the American practice with V-slides, the shape of the slides thus differing from the common German practice which employs perfectly flat ways. The power feed of the machine is friction driven and the lead-screw together with its driving gears is running only when the lathe is used for thread cutting. The power feed is stopped, reversed and varied in amount by means of a knob conveniently placed for the operator. The action of the lead-screw is controlled by means of a handle placed on the apron, and a quick return is provided for the carriage when cutting screws, which saves considerable time when cutting long threads. The feed rack, as well as all gearing in the apron, is made of steel.

A motor-driven vertical turning and boring mill of neat design is shown in Fig. 2. This machine is provided with a speed-changing mechanism furnishing sixteen changes of speed for the revolving table, and controlled by conveniently placed levers. The feed is friction driven, as shown on the right side of the machine and changes in feed can be made without stopping. The cross-rail of the machine is raised and lowered by means of an independent motor placed on the top of the machine as shown in the engraving. The vertical slides are balanced according to modern practice with two independent counterweights and can be set at any angle with the cross-rail required. The tool-holders are of special interest, as they permit of very accurate adjustment. They can be swiveled around a stud in the center, and have also a longitudinal slide adjustment. The machine is of very powerful design, intended to be able to stand heavy strains, and practically all gears are made of steel. This machine is also provided with cone pulley belt drive when required. In this case the cross-rail is operated from an independent counter-shaft and pulleys are placed on the top of the machine where now a motor is located.

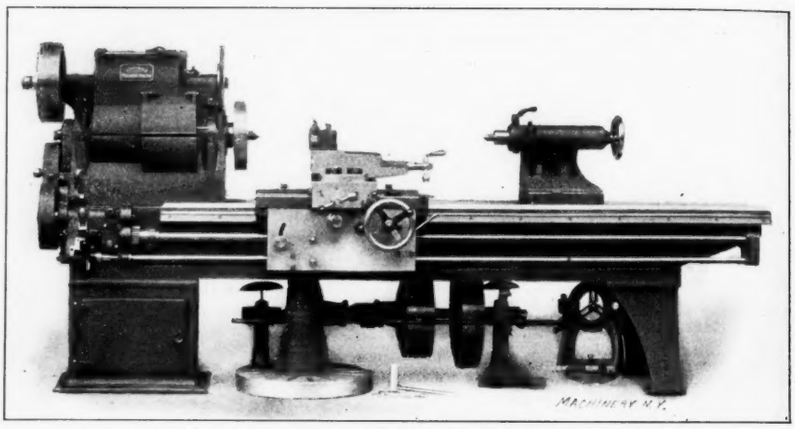


Fig. 3. Geared-head Lathe built by Kopings Mekaniska Verkstad, Koping, Sweden.

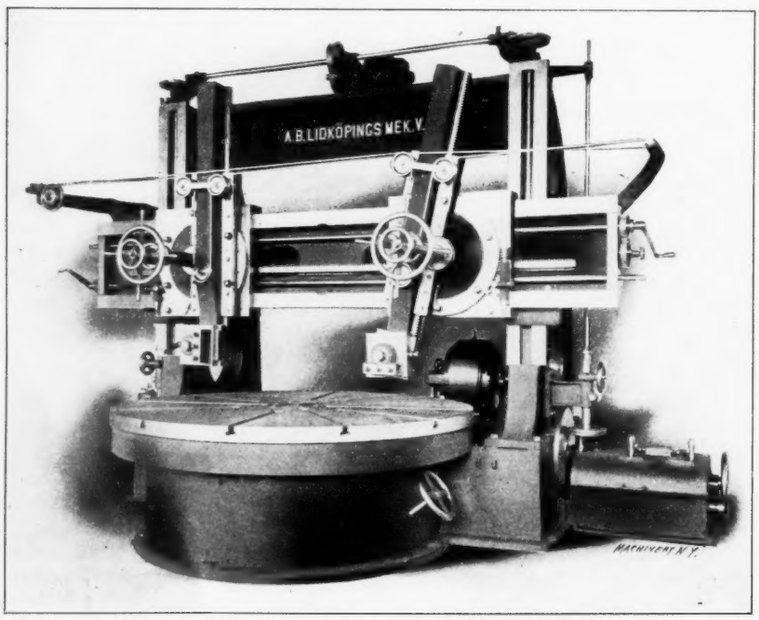


Fig. 2. Vertical Turning and Boring Mill of Swedish Manufacture.

In Fig. 4 is shown a high-speed radial drill built by the same company. This machine is provided with a single pulley drive and a gear box; ten spindle speeds are obtained partly by changes in the speed box and partly by the back gearing in the spindle head. As indicated by the arrangement of the pulleys in the illustration, the power is transferred from the gear box to the spindle by means of belts. The drill spindle can be swung to any angle within an arc of slightly more than one-hundred-eighty degrees, and the auxiliary table shown mounted on the main part of the machine can be tilted to angular positions for drilling holes at angles with the base of the work.

Figs. 3 and 5 to 9 illustrate a number of machines built by Köpings Mekaniska Verkstad, Köping, the foremost machine tool building firm in Sweden. The reputation of this firm is due fully as much to the high class of workmanship exhibited in its machines as to the modern and up-to-date design. It may be said in general as regards design of Swedish machine

† Address: Hornsgatan 45, Stockholm, Sweden.

tools that they do not embody all the special labor-saving features of American machines, which may be of great importance in certain special lines of manufacture, but which

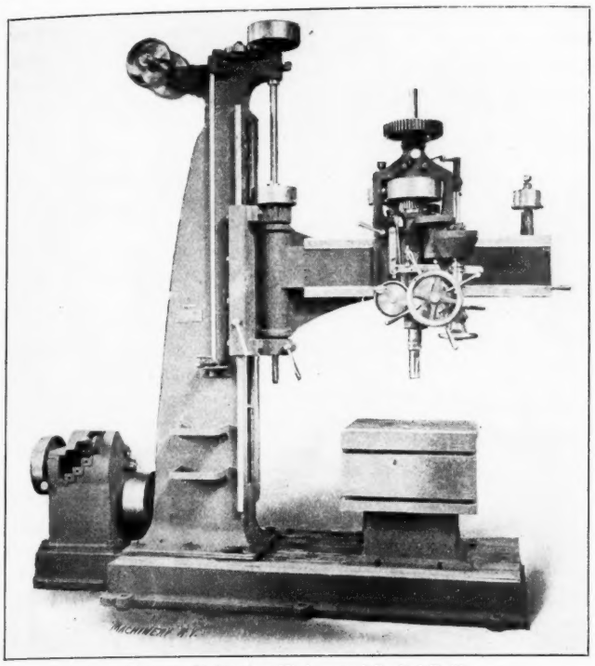


Fig. 4. Lidkoping High-speed Radial Drill.

are often of small value for general lines of work; and the aim sought by leading Swedish firms is to design machine tools without too many complicated features, making them easy to operate and of a rigid design and good workmanship. Köpings Mekaniska Verkstad is largely specializing in the lathe line, but as will be seen in the accompanying illustrations, the firm is also making several other kinds of machine tools mainly in order to keep fully employed even when the demand in the lathe business is less heavy.

Fig. 3 shows a high-speed geared-head lathe provided with all the ordinary features of up-to-date lathe designs. The number of spindle speeds obtainable through the change gears in the head is nine. The longitudinal and cross power feeds for the carriage and tool slide are obtained through a friction clutch arrangement. The feed is positive and gear-driven and can be easily changed while the

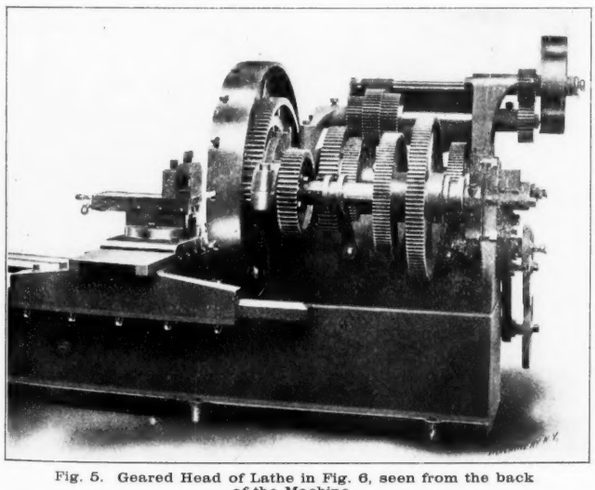


Fig. 5. Geared Head of Lathe in Fig. 6, seen from the back of the Machine.

machine is running. The lead-screw is independent of the feed for ordinary turning, the same as in all modern lathe designs, thus preventing unnecessary wear of the threads when not used for thread cutting.

A large, heavy duty engine lathe is shown in Fig. 6. Fig. 5 shows a back view of the same machine with the guards over the geared-head mechanism removed so as to show the arrangement of the gears very plainly. In regard to guards for gearing and moving parts on machine tools, it may be remarked here that the careful covering of all gearing which is so plainly in evidence in all German machine tools is not quite so prominent in Swedish tools. In this respect the Swedish tools possess practically the same features as did, until lately, the general run of American machines, where only the most important and more dangerous combinations of gearing were covered. It is to be hoped, however, that the German practice of covering all gearing with guards forming as nearly as possible an integral, or at least a homogeneous, part of the machine will become a common practice everywhere. The geared head in the machine illustrated permits fifteen speed changes for the spindle, the arrangement of gears through which these changes are obtained being plainly indicated. The feed is gear driven and consequently is positive. A novel arrangement for obtaining four different feed changes at the apron in addition to the usual changes, is introduced. This makes the changing of the feed while the machine is running very convenient to the operator. The kind of tool-post employed on the Köping lathes differs from the usual form, and is especially adapted for heavy, square lathe tools.

A machine embodying some rather interesting features is shown in Fig. 7. This side planing machine, also known as the Richard planer, is particularly valuable in cases where large castings are handled, which are often difficult to plane on the ordinary types of planers. The carriage which is provided with an exceptionally long slide is driven by a square-threaded screw engaging two adjustable nuts. The screw is

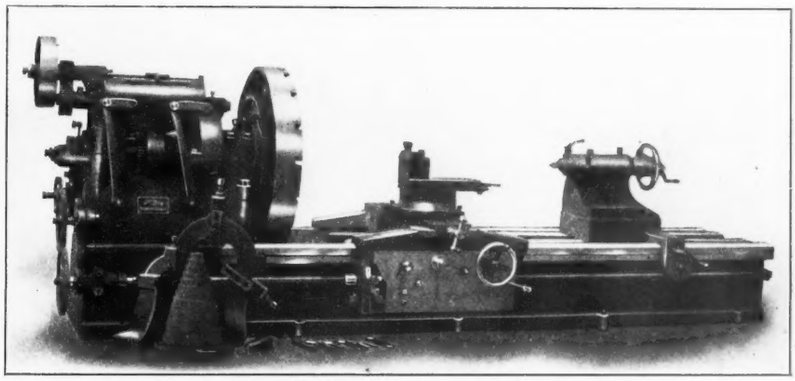


Fig. 6. Koping Heavy-duty Engine Lathe.

driven by means of a belt on a tight and loose pulley. The reversing mechanism is provided with a bevel gear clutch reversing arrangement, a feature which has been introduced recently, and replaces the old method of reversing by means of shifting the belt from the forward to the return pulley. The small sizes of these side planers are provided with one work-table placed on a slide on the side of the machine, and the larger sizes are provided with two or more of these as shown in the illustration. This table can be easily removed when it is required to plane very large castings. A large pit is usually provided in the front of the machine so as to give ample space for large pieces to be machined. An extension for the tool-carrying arm is also provided in order to make it possible to plane surfaces which are out of reach of the ordinary arm. While the machine is substantially constructed, it is evident that on account of its peculiar design it does not permit of very heavy chips to be taken, as compared with the possibilities of the ordinary planer.

The universal milling machine shown in Fig. 8 is an interesting example of a high-class machine tool embodying in its design a combination of American, German and Swedish features, the first mentioned being most prominent. The machine is provided with power feed in three directions, the number of different feeds obtainable in each direction being twelve. The speed-changing mechanism permits of sixteen different spindle speeds. Automatic stops are provided for

the feeds in all directions. It will be noticed that the telescopic feed-driving shaft commonly used on American designs is not employed.

In Fig. 9 is shown a high-speed upright drill press. In this machine six different spindle speeds are obtainable; of these

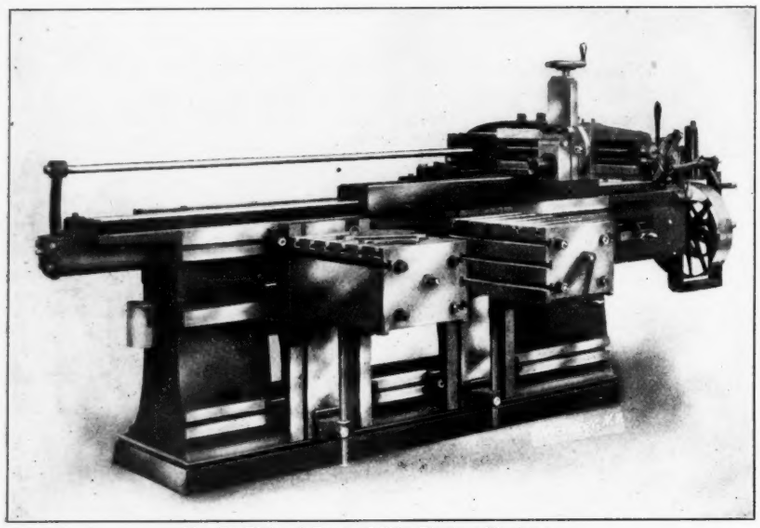


Fig. 7. Richard Type of Side Planing Machine.

three are obtained by means of a gear box and these are multiplied by two by the back gears. The feed is positive, three speed changes being provided for each spindle speed. The circular work-table can be swung out of the way whenever it is required to use the base plate for large work.

The accompanying examples of Swedish machine tools indicate in a general manner the present state of the art in that country, and indicate the present development. While it is evident from the illustrations that the designs largely follow along the lines of American and German built machines, the high class of workmanship put into these machines should be emphasized. This has been one of the strong claims of

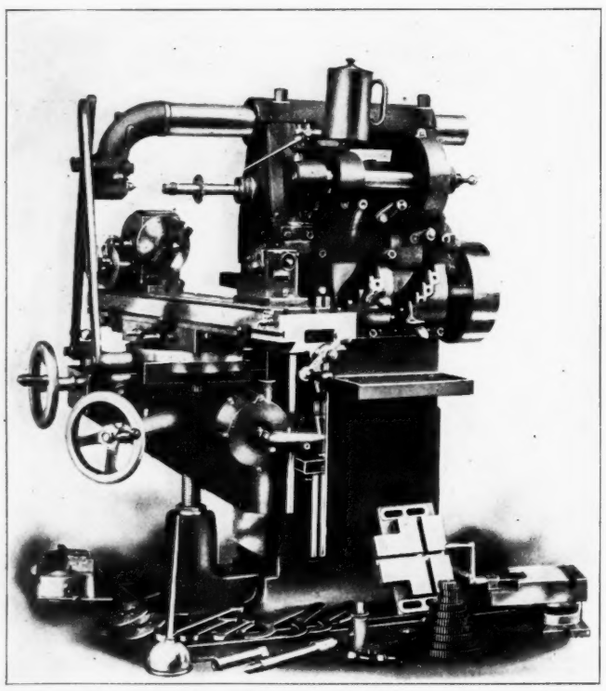


Fig. 8. Milling Machine, combining in its design American, Swedish and German Features.

the Swedish machine tools in the past and has enabled the Swedish machine tool builders to hold their own in competition with foreign-made tools.

* * *

The lawyer reasons by precedent; the engineer by cause and effect.—*Common Sense.*

STEAM PIPE SIZES.*

CHARLES L. HUBBARD.†

The problem of determining the size required for steam pipes under varying conditions is one which often confronts the engineer, and the difficulty of obtaining reliable data is well known. In order to facilitate work of this character, the tables given in the current Supplement have been computed. Tables I, II and III (Plates I and II) are computed from D'Arcy's formulas for flow of steam in pipes, which are given in the Supplement in connection with Table IV, which gives the value of constants used in these formulas for various diameters of pipe.

Table I gives the flow of steam in pounds per minute through pipes 100 feet in length, for initial pressures of ¼ to 5 pounds, assuming that the pressure in each case drops to zero. That is, the drop in pressure equals the initial pressure. It is seen from the table, for example, that a 2-inch pipe will discharge 2.9 pounds of steam per minute under a pressure of ¼ pound per square inch, or 14.9 pounds under a pressure of 5 pounds, the terminal pressure dropping to zero in each case. The table is sufficiently accurate for any initial pressure less than 10 pounds for the drops in

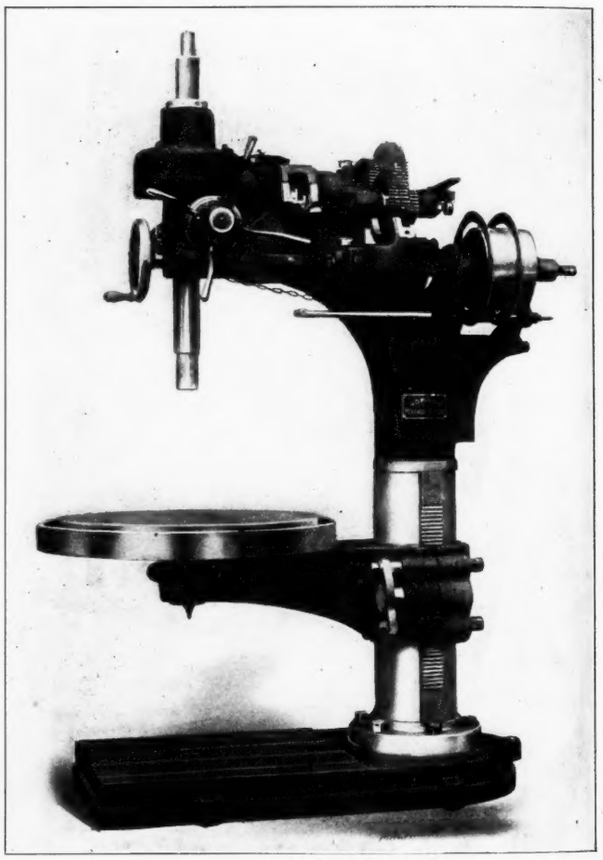


Fig. 9. Koping High-speed Upright Drill.

pressure noted at the heads of the columns, regardless of whether the pressure falls to zero or not. For example, a 4-inch pipe, 100 feet long, will discharge approximately 18.1 pounds of steam per minute with a drop in pressure of ¼ pound, or 91.9 pounds with a drop of 5 pounds, for any initial pressure up to 10 pounds.

As the initial pressure increases, the quantity of steam discharged for a given drop in pressure becomes greater than given in Table I. Table II gives correction factors for higher initial pressures. For example: The factor for a drop of 5 pounds at an initial pressure of 80 pounds is 2.09, so that

* With Data Sheet Supplement.

† Address: 283 Central St., Auburndale, Mass.

under these conditions a 4-inch pipe will discharge $91.9 \times 2.09 = 192$ pounds of steam per minute, the value 91.9 having been obtained from Table I.

The figures given in Table I are for pipe runs of 100 feet only. For different lengths, the results should be corrected by the factors given in Table III. For example: A 4-inch pipe, 100 feet in length, will discharge 91.9 pounds of steam per minute with a drop in pressure of 5 pounds at the discharge end; if the pipe is only 50 feet in length, it will discharge $91.9 \times 1.41 = 129.5$ pounds, or if it is 500 feet in length, it will discharge $91.9 \times 0.45 = 41.4$ pounds.

Examples in the Use of Tables.

What weight of steam will be discharged per minute through a 3½-inch pipe, 100 feet long, with an initial pressure of 40 pounds, and a drop of 3 pounds?

$$47.8 \times 1.70 = 81.3 \text{ pounds.}$$

What size of pipe will be required to deliver 51.3 pounds of steam a distance of 100 feet, with an initial pressure of 60 pounds, and a drop of 2 pounds?

The factor for 60 pounds initial pressure and 2 pounds drop is 2.02, and $\frac{51.3}{2.02} = 25.4$, which in Table I corresponds to a 3-inch pipe.

What weight of steam will be discharged per minute through a 5-inch pipe, 600 feet long, with an initial pressure of 5 pounds, and a drop of ½ pound?

$$45.7 \times 0.40 = 18.3 \text{ pounds.}$$

The tables given may be applied to either power or heating work, or to any conditions where the quantity of steam used can be reduced to pounds per minute.

Engine Connections.

Steam pipes for engine connections are commonly based on a velocity of 6,000 and 8,000 feet per minute for the steam and exhaust pipes respectively, assuming the entire cylinder to be filled with steam at each stroke. This gives approximately 0.14 square inches internal area per H. P. for the steam pipe and 0.20 square inches for the exhaust. For example, a 100 H. P. engine would require

$100 \times 0.14 = 14$ square inches, or a 4-inch steam pipe.

$100 \times 0.20 = 20$ square inches, or a 5-inch exhaust pipe.

Tables V, VI, and VII, finally, give the diameters of pipe required for heating purposes.

* * *

THE DISTURBING EFFECT OF CENTRIFUGAL FORCE ON HIGH-SPEED CUTTERS.

The manufacturers of wood-working machinery have found the effect of centrifugal force a very troublesome factor in high grade wood planers. It has been found practically impossible to build a planer cutter head that will stay so well balanced that it will not run out at speeds of say 4,000 revolutions per minute sufficiently to leave distinct cutter marks on the lumber planed. The slight eccentricity due to lack of perfect balance causes one knife to cut deeper than the other three. The result is irregular work that will not pass inspection where the product is employed for fine furniture. A circular issued by the S. A. Woods Machine Co. of Boston, Mass., is devoted to this matter, and describes an attachment for truing up planer cutter heads at full speed. The circular in pointing out the nature of the difficulty, states that the effect of centrifugal force is far greater than is ordinarily supposed. One pound of metal revolving at 4,000 revolutions per minute, in a circle of six inches diameter, exerts a radial force of over 1,700 pounds. On the same basis a 7-inch cutter head, which is an ounce out of balance, would have to stand a strain of 125 pounds, tending to throw a knife edge out of perfect concentricity with the others. So it follows that even if cutter heads were in perfect balance when built, they could not remain so because of slight inequalities developed by grinding and wear; hence the practical necessity for truing these knives up when running at speed and thus elminating the effect of the disturbing influence. The truing device is in the nature of a lathe turning tool, guided by a straight bar, an emery stick held in a suitable holder and traversing along the cutter head when at speed being employed to remove a small amount of metal from the blade projecting beyond the others.

APPROXIMATE FORMULAS FOR SIZES OF BEAMS AND GIRDERS.

C. R. WHITTIER.*

In determining the size of a beam to carry a uniformly distributed load, it is customary to use the tables in the various steel companies hand-books as follows: The total load and span are given. The size is tentatively found by selection from the load tables; the weight of the beam thus provisionally determined is calculated and added to the load; and then a second reference is made to the tables to see that the total capacity is not exceeded.

A more rapid, and closely approximate method for determination without tables is developed below. It is founded on the well-known fact that I-beams and plate girders resemble open beams or trusses. In the ordinary truss with uniformly distributed load, the horizontal stress at the center of either chord is approximately the total weight times the span, divided by 8 times the height—all in inch pounds. Applying this to an I-beam flange, we have for 16,000 pounds fiber stress:

$$\frac{Wl}{8h} = 16{,}000 \times \text{area of flange.}$$

As the area of the flange is practically one-third the area of the cross-section of the beam:

$$\frac{Wl}{8} = \frac{A}{3} \times 16{,}000\, h.$$

Transforming the left-hand member of this equation to inch-pounds, we have:

$$\frac{2{,}000\, W \times 12\, l}{8} = \frac{A \times 16{,}000\, h}{3}$$

[The assumption that the area of the flange is one-third the area of the cross-section of the beam is only approximately correct. The area of the flange varies in proportion to the total area of the beam from 0.26 for the larger sizes of standard I-beams to 0.37 for the smaller sizes. It should also be remarked at the outset that the approximate formulas in the following apply only to the minimum or standard sizes of I-beams.—EDITOR.]

In I-beams it is found, closely enough for our present calculations, that $A = h - 2$.

[More accurately A varies between $h - 0.68$ and $h - 2.74$ for different sizes of I-beams.—EDITOR.]

Introducing this value of A, reducing, and solving for h, we have:

$$h = \sqrt{0.56\, Wl + 1} + 1$$

The quantity 1 under the vinculum is so small as to be negligible.

The coefficient 0.56 needs further modification to allow for the average weight of the beam itself, which value is taken as equivalent to $3.5\, h - 10$ per foot; also a correction for using h as the distance between extreme fibers instead of the distance between the center of gravity of the flanges, and an allowance for the strength of the web. This changes the coefficient to 0.6, giving as a final formula:

$$h = \sqrt{0.6\, Wl + 1}$$

This is so simple that it can be solved mentally. Thus h may be determined without reference to the tables for all preliminary work. A trial in comparison with the tables will be convincing proof of its accuracy. It applies *only to the minimum sections*, as these are always used if possible.

Similar formulas have been deduced for minimum sections of channels, Z-bars, angles with equal legs, and tees with stem and flange equal; also for plate girders of the ordinary dimensions tabulated in Carnegie Steel Co.'s hand-book, as shown on the following page.

The formulas reduce to this simple form because the relation between weights and areas of beams, if plotted, closely approximates a straight line.

Incidentally, it may be stated that a closer approximation is given by the following formulas:

Weight per foot of I-beams, minimum section $= 0.07\, h^2 + 1.7\, h$ pounds.

* Address: 204 West 111th St., New York City.

Area of I-beams, minimum section $= 1.1\,h - 3$ square inches.

The average weight per foot of plate girders of standard dimensions (Carnegie Steel Co.) in pounds, is

$$\text{weight} = 0.1\,h^2 + 2\,h.$$

Memorizing the formulas which are most useful to the work in hand enables one to make mental calculations without reference to tables.

Another handy approximate rule, *good for all standard weights* of I-beams, and depending on l in feet, W in tons, and w (weight of beam per foot) in pounds being known, comes from the following well-known relation: When depth

BEAMS OF MINIMUM SECTION.

h = height in inches, l = span in feet, W = load in tons.

Shape.	Maximum Fiber Stress.	For Uniformly Distributed Load.	For Center Load.
I-beam	16,000	$h = \sqrt{0.6\,lW} + 1$	$h = \sqrt{1.2\,lW} + 1$
Channel	16,000	$h = \sqrt{lW} + 1$	$h = \sqrt{2\,lW} + 1$
Z-bar	16,000	$h = \sqrt{lW}$	$h = \sqrt{2\,lW}$
L (equal legs)	16,000	$h = \sqrt{lW} + 1.3$	$h = \sqrt{2\,lW} + 1.3$
T (equal legs)	16,000	$h = \sqrt{lW} + 1$	$h = \sqrt{2\,lW} + 1$
Plate girders	15,000	$h = \sqrt{0.5\,lW}$	$h = \sqrt{lW}$

of beam in inches equals span in feet, then, weight of beam per foot in pounds equals load in thousands of pounds; other loads vary inversely as their lengths.

Then, changing the load from pounds to tons, it follows that

$$\frac{w\,h}{2\,l} = W, \text{ and}$$

$$h\,w = 2\,l\,W$$

As w depends on h, a value of h must be selected by trial to balance the equation.

* * *

MECHANICAL IMITATION OF GRAVITAL FORCE.

An interesting account of experiments conducted by Prof. Arthur Korn in gravitation was recently published in the *Westminster Gazette*. Prof. Korn has constructed a machine which mechanically imitates the action of gravital force in a way visible to the eye. He apparently demonstrates that gravitation is a mode of motion, inasmuch as by rapid vibration he causes bodies to attract one another which are under the influence of the vibratory force with a force proportional to their mass.

Prof. Korn started with the assumption that gravitation is the result of the vibration of elastic bodies in an inelastic medium. All matter is in a state of eternal vibration. The vibration according to the professor, is analogous to the vibration of a violin string. The third string of a violin, for instance, rightly tuned, emits an A. In addition, however, to the ground tone A, there are the so-called over-tones in the relation of 1 to 2, 2 to 4, and so on. Of complex character are the vibrations of all particles of matter, and it is these vibrations which lead respectively not only to the attractive force of gravitation, but also to the repulsive force which, in the case of the heavenly bodies, is observed at the same time.

The machine constructed by the professor to produce this "artificial gravitation" is extremely simple. A metallic globe, fitted with a window for observation of what is going on inside it, is united by tubes with a cylinder, one end of which is closed only by a membrane. To this membrane is attached an electro-motor, which, by pushing and pulling the membrane alternately, makes rapid pulsations. The metal globe contains two air-filled india-rubber balls of different sizes. The larger one is fixed firmly to the inside wall of the globe; the smaller is free to move whither it likes. The whole apparatus is then filled with water, and the motor set to work. Each time the membrane is pressed in, the increased water pressure causes the rubber balls to contract, and each time the membrane returns to its original position the relaxed pressure of the water causes the two balls to expand. The motor is set working so quickly that these pulsations become inconceivably rapid vibrations, and the contraction and expansion of the balls is invisible to the eye. As water is practically incompressible, Prof. Korn thus obtains the conditions he needs—he has two elastic bodies vibrating in an inelastic medium. Then the phenomenon looked for occurs. When the vibrations attain a certain speed, the smaller ball, impelled by a mysterious force, begins slowly to move through the water to the larger ball, and gradually increases its speed, exactly as the apple observed by Newton increased its speed as it fell nearer and nearer to the ground.

So far, this was merely a puzzling phenomenon; but that it was gravitation, and no other force, which drew the balls together was soon proved. Measurements showed that the bigger ball attracted the smaller exactly in accordance with Newton's law, or in inverse ratio to the square of the distances between them. It became, therefore, possible to construct an exact working model of the solar system in water, in which the planets should all move in their appointed paths without any visible support or externally-applied power.

Prof. Korn's researches do not end here. He had shown why matter attracts matter, but he had to solve the problem why matter also repels matter. Why is it, for instance, that comets, after rushing directly towards the sun from the depths of infinite space, never collide with it, and invariably return whence they came? To this problem the professor again applies the musical-vibration theory. Just as there are over-tones in the violin string, so in the vibrations of matter there are over-vibrations. These over-vibrations come into play when the attracted bodies come too near, and their effect is immediately repulsive. They are counter-gravitational in their effect, and operate in this way also only in an inelastic medium like water. In an elastic medium the vibrations of matter would have no attractive or repulsive effect; hence it follows that gravitation depends entirely upon the fact that all the heavenly bodies are surrounded by inelastic ether.

* * *

NEW COOPERATIVE TRADE SCHOOL.

A cooperative plan of shop and school instruction for boys has, according to the *Iron Age*, been instituted in Chicago, along lines similar to those in operation at the University of Cincinnati, and at the high school in Fitchburg, Mass. In Chicago, the manufacturers send their apprentices to the Lewis Institute one-half of the time, one week being spent in the shop, and the next week in the school. The course extends over two years, but it is not the intention either of the manufacturers or the instructors of the Lewis Institute to turn out a skilled workman in this time. The idea is simply that the boy will be able to develop intellectually, and grasp the principles of his trade more quickly, than he otherwise could. Each manufacturer is represented in the school by units of two boys, one boy working in the shop, while the other is in the school. The employer pays a tuition fee of $50 a year for each apprentice sent to the Institute, and pays the boy $5.00 a week for each week he works in the shop. Two weeks' vacation from the school instruction is given in the summer, but twenty-six weeks are spent in the shop.

The school instruction comprises eight hours a day for five days in the week. Instruction is given in the physical sciences and the principles of mechanics, mechanical drawing, mathematics, English and history, and in shop work, supplementing the productive work done by the boys in the metal working shops. A boy who has taken this course at the Institute and in the shop will still have to continue his apprenticeship in the shop, but it is expected that it may be possible to reduce the time of the apprenticeship as a result of the better education of the boy. The Lewis Institute has equipment for the instruction of sixty boys in this course.

* * *

BRITISH MACHINE TOOL TRADE.—In a note published in the November issue on the English machine tool trade in the London district, it was mentioned that the firm of Henry Pels & Co. had enough work on hand to keep several shifts busy for several months, and that it was contemplating considerable extensions. The idea conveyed was that the company has a plant in Great Britain, which is incorrect. All the tools sold by the company in Great Britain are imported from the Continent.

MANUFACTURING AIR-COOLED CYLINDERS.

F. J. HAYNES.*

The process of manufacturing air-cooled cylinders of the type used by the H. H. Franklin Mfg. Co., Syracuse, N. Y., on the Franklin automobiles, differs radically from the operations used in manufacturing water-cooled motor cylinders. The operations are of considerable general interest from the manufacturing standpoint, and in the following article a few processes are illustrated and briefly described.

The motor cylinder of the Franklin car is made from cast iron, and cast in a separate piece. On the exterior of the cylinder are mounted phosphor-bronze rings, which increase the radiating surface. After the casting has been made, it is first inspected; the things to be noted at this time are that the casting is sound in all respects, having no blow holes or other defects; that the cores are located centrally, and the dimensions of the core holes correct and that the bosses are in proper position. Then the casting is sand blasted to remove all core sand; this saves the cutting edges of the boring tools.

The cylinder is bored on a Gisholt turret lathe. The boring bar is guided in the spindle by a bushing, and the cylinder

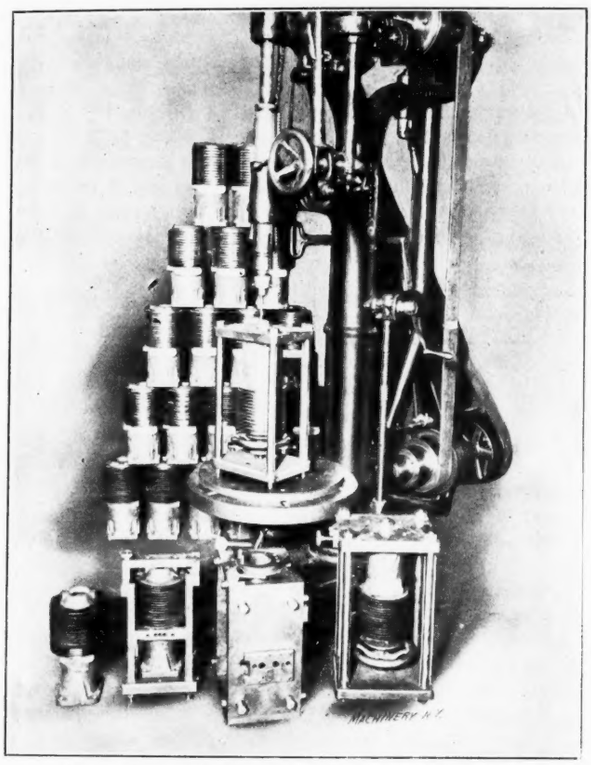


Fig. 1. Drilling the Cylinders, and Jigs for this Operation.

is bored within 0.015 inch of the finished dimension. The dome head is machined simultaneously with the boring of the cylinder, and the base is faced off at right angles to the bore, the proper distance from the base to the center of the auxiliary exhaust port being made the right dimension at the same time. In machining the dome head, considerable care must be taken to avoid forcing the forming tool to one side, as this would result in throwing the dome head off center. These operations are very severe on the tools; carbon steel cutters will last only a short time, and even high-speed steel tools must be carefully watched. The boring and the facing operations are illustrated in Fig. 3.

The cylinder is now submerged in water, and tested with compressed air of eighty pounds pressure. Any porous or unsound places will be revealed by the leakage of the air. Of course, if the cylinder shows leakage in this test, it is "scrapped" before any further operations on it are performed. If it passes the test, it goes to the next operation, consisting of rough turning and grinding. During the grinding operation, and also during the later operation of grinding the bore of the cylinder, it is flooded with water, and kept at a temperature of 70 degrees F. It is necessary to keep the water at this temperature, by adding either cold or warm water, otherwise the micrometer measurements taken by the operator, and those taken by the inspector, will not agree. If the water is too cold, the dimension of the cylinder will be too large when the cylinder has acquired the temperature of the room; if the water is too hot, the cylinder will be too small when cooling down. When the cylinder has been accurately ground to the exact size outside, it is again tested by compressed air under water. If no leaks develop, it

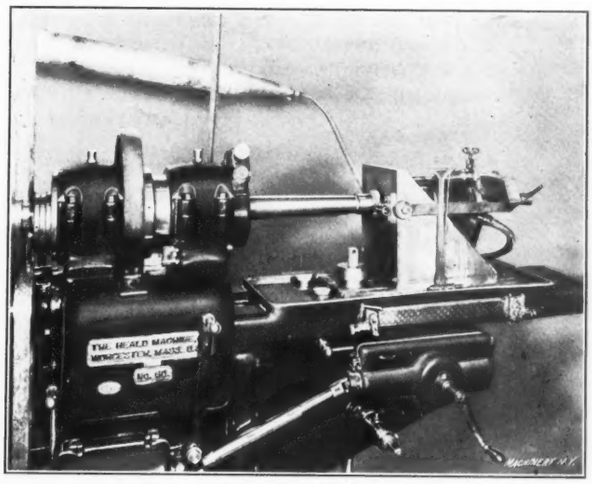


Fig. 2. Grinding the Cylinder Internally.

passes to the inspection room for checking of the outside diameter. When this is done, the phosphor-bronze rings are applied.

These rings are punched in a combination die which produces a complete ring for every stroke of the press. Before being applied to the cylinder, they must be accurately bored for a shrink fit. The allowance for the shrink fit is carefully calculated, so as to be within the elastic limit of phosphor-bronze when the rings are shrunk in place. On the other hand, due consideration should be given to the fact that the rings must not work loose, due to their expansion caused by the heat of the cylinder when in use. After boring, the rings are heated in an oil bath to the exact temperature required, and are placed on the cylinder with split steel washers between the rings.

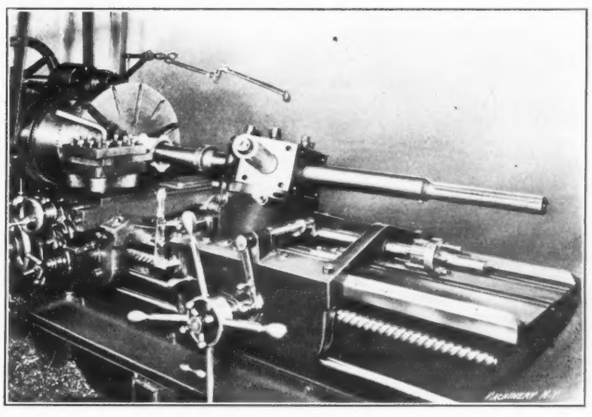


Fig. 3. Boring and Facing the Cylinder.

The remaining work on the cylinder, such as facing the bosses, drilling and tapping the holes, etc., is now carried out with the exception that the concentric valve seat in the dome head is only roughed out to within a few thousandths of the correct size. The drilling and the tapping of the holes is done in jigs, as shown in Fig. 1. When these operations are performed, the cylinder is again inspected, and if found correct, it passes again into the grinding room to have the bore ground. The cylinder is placed in a cylinder grinder, by fastening it to a large angle plate provided with a hole of the same size as the bore. The grinding wheel enters

* Address: Superintendent, H. H. Franklin Mfg. Co., Syracuse N. Y.

through this hole, as shown in Fig. 2. The grinding machine is of the type where the grinding wheel has a planetary motion, besides its regular revolving motion, so that the work itself does not revolve. The finish grinding of the bore is performed last, in order that the pressure due to the shrinking on of the phosphor-bronze rings may have no effect on the final dimension of the bore.

When the grinding operation is completed, the cylinder passes to a large heavy lathe, fitted with a special face-plate and compound rest, as shown in Fig. 4, which is used only for finishing the concentric valve seat. As a roughing cut has already been taken on the valve seat the finishing cut merely insures that the angle of the valve seat is correct, and the surface round and true. The valve seat is tested for its accuracy with a hardened taper plug, ground to the exact shape and size of the finished seat, and smeared with

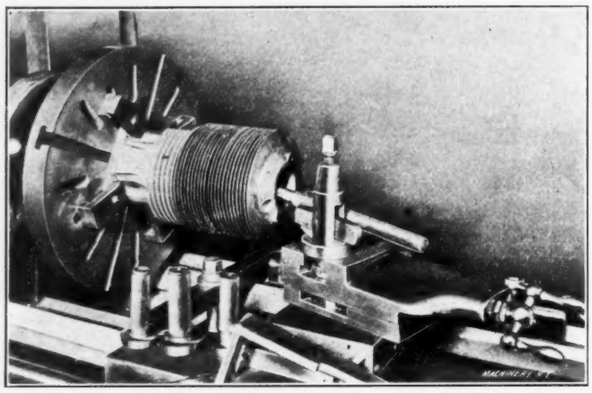


Fig. 4. Finishing Valve Seat Hole in Top of Cylinder.

Prussian blue. When this operation is finished, the cylinder passes through the final inspection, and is then delivered to the stock-room for finished work.

The cylinder, some stages of the finishing of which are shown in the accompanying illustrations, is of 4½-inch bore, and is 11 9/32 inches long over all, and weighs 16⅝ pounds when fitted with the phosphor-bronze rings. The wall of the finished cylinder is 3/16 inch thick. All of the inner surface and one-half of the outside surface is machined; thus there are no uneven thicknesses of metal, and the design enables a very light cylinder to be produced. It is interesting to note that, in all, the cylinder passes through thirty-two operations before completion.

* * *

Mr. Bethel, foreman of the manufacturing department of the Taft-Peirce Co., Woonsocket, R. I., has a blueprinted placard tacked on the shipper rod of each of his lathes. This placard reads as follows:

LATHEMEN—ATTENTION.

Be sure

That lathe is well oiled.
That lathe and work are kept orderly.
That live center runs true.
That tail center is smooth.
That tail center is hard.
That both centers are 60 degrees.
That center holes in work are clean.
That center holes in arbor are clean.
That arbor runs true.
That arbor is smooth and does not rough hole in work.
That wrenches are kept with lathe.
That you take your work to be inspected every two hours.
That you work to figures.
That at least one hour before your job is completed you notify your foreman.

This list of instructions, which somewhat resembles in positive form the "don'ts" we published some time ago, combines a number of points which are commonly understood, but are as commonly neglected. By placing this list where it is before the men constantly, and holding them responsible for following it, a noticeable improvement in the quality of the work was effected.

* * *

With an engineering education you know the relation of knowledge with its use.—*Common Sense.*

MACHINE SHOP PRACTICE.*

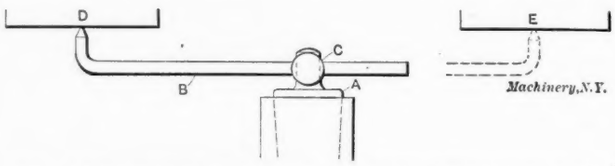
MACHINING A THREE-THROW BUILT-UP CRANK-SHAFT.

W. BURNS.†

As the machining and building-up operations on a crank-shaft of the built-up type, are usually done by the same men in the shop, one may be employed for considerable time without having the opportunity of obtaining experience on work of this class; and should one chance to be called upon to do such work when starting in a new shop, he might be quite at a loss to know how to proceed. A short description, therefore, covering some of the salient points in connection with this work, may be of interest.

The largest sizes of the three-throw shafts are usually made up of three separate cranks, each machined and built up separately, and then all connected in their relative positions to one another by means of solid forged couplings on each shaft. There are, however, a very large number of three-throw crank-shafts shrunk together into one solid shaft and then turned after the building-up operation. As it is a much easier proposition to machine a single crank and then connect it to other cranks by means of coupling bolts, than to machine, shrink together, and then turn a three-throw shaft, a brief description of the work involved in the latter will be given. Illustrations showing the construction of a built-up shaft will be found on the Shop Operation Sheet accompanying this issue.

The forgings for the different parts of the shaft and the crank-pins, should first be roughed out to within 3/16 or 1/4 inch of the finished size. It is not necessary to face the ends to the correct length and center anew, as it is not essential that the centers be left in the finished work, in this case, as is desirable for some shafts. When the different parts of the



Tool for Setting Lines Concentric with, or Surfaces at Right Angles to, the Axis of a Horizontal Boring Mill Spindle.

shaft are being roughed out, they should all be turned to the same diameter, as this uniformity makes it much easier for the erector to produce a true shaft when shrinking the parts together. This, however, does not apply to the crank-pins, as they are finished to fit the holes in the webs and turned to finish size on the body before being shrunk in place. When turning the coupling end, the inside face and the fillet should be roughed out first, as the forging is sometimes defective in this part, and should it chance to be condemned because of any defect, little machine work will be lost. Occasionally, a flaw in the metal may be discovered near the center of the shaft when facing the outside of the coupling. If such a defect appears, it should be examined carefully to determine, if possible, the distance it penetrates into the shaft.

Before any of the cylindrical parts are machined, however, the webs are first finished as the crank-pins and the ends of the shaft proper are turned to a shrink fit for the holes in the web. These webs are usually forged solid, which means that a large amount of metal has to be removed in boring the shaft and crank-pin holes. Sometimes, however, small holes are punched for the crank-pins and shaft so as to reduce the time required for the boring operation. When machining the webs, the thickness and the distance between the shaft and crank-pin holes are the most important dimensions. It is also essential that the holes be bored out very true to the face of the webs, that is, at right angles, as no machining is done on them after the crank is shrunk together. The method of setting the angle-plates, described on the Shop Operation Sheet, will, as will be understood by referring to the Supplement, bring the faces of the angle-plates in line with the cross travel of the table. In a well-built machine this cross travel will be at right angles with the axis of the spindle, and, in that case,

* With Shop Operation Sheet Supplement.

† Address: 16 Golfview Terrace, Paisley Road West, Glasgow, Scotland.

the angle-plates will be correctly set. By the use of a special tool, such as the one here illustrated, the setting of the plates may be tested directly from the spindle, which is a desirable thing to do, as then any error in the machine table will not be reproduced in the work. This tool consists of a shank *A* which fits in the spindle, and has passing through its outer end a gage wire *B* which is adjusted in and out and held in position by a knurled thumb-screw *C*. The faces of the two angle-plates *D* and *E* may be tested by bringing this gage point into contact with one, and then revolving the spindle one-half of a revolution. This moves the gage to the position indicated by the dotted lines in the illustration, and obviously, if the plane in which the two faces of *D* and *E* lie, is at right angles with the axis of the spindle, the point of the gage will just touch the face of each plate. By the insertion of a wire *B* having a sharpened point, circles scribed on the work may also be accurately set concentric with the spindle, by revolving the spindle and gage and adjusting the work until the pointer follows the line on it.

The outside edges of the webs are machined after the sides have been planed and the holes bored. These edges are occasionally painted when in place on the engine, and, in that case, often they are only rough machined. When all cylindrical parts are turned to fit the webs, the shaft is ready to be shrunk together. This might seem like a rather complicated job, especially when doing it for the first time, but if one keeps cool (which is not an easy thing to do when two big bunsen burners are playing on the web) no trouble will be experienced. When the shaft is shrunk together it is placed in the lathe for the final turning operation and all the parts of the shaft proper, or the journals, are finished as described on Shop Operation Sheet No. 93, thus bringing them into alignment. Considerable care has to be exercised when performing this last operation to obtain a shaft which is round and not sprung to any appreciable extent. It is hardly practicable, however, to finish a large three-throw crank-shaft which will not show slightly out of true when being bedded in place in the bushings in the sole-plate.

* * *

TESTS ON CRANK SHAPERS.

Some interesting tests on crank shapers were recently undertaken by the Queen City Machine Tool Co., Cincinnati, Ohio, with the purpose of ascertaining the horse-power required for taking ordinary cuts on motor-driven crank shapers. The tests were made on the 16-inch and the 24-inch back-geared crank shapers manufactured by the company. A 5-horse-power constant-speed motor was used for driving the smaller machine, and a 20-horse-power motor for the 24-inch shaper; 220-volt current was used. A regular cone pulley drive was employed, the counter-shaft being driven by the motor. The required revolutions per minute of the counter-shaft were obtained by reduction through pulleys, so that the counter-shaft for the 16-inch shaper was running at 300 revolutions per minute, and the 24-inch shaper counter-shaft at 330 revolutions. The length of the stroke in the tests on both machines was 16 inches, which is the rated capacity of the smaller shaper. All the cuts were made with the back-gears thrown in, the 16-inch shaper being run to obtain an average cutting speed of 24 feet per minute, and the 24-inch to obtain a speed of 22 feet per minute.

TESTS ON 16-INCH CRANK SHAPER.

Depth of cut, ½-inch.

Feed.	Net Amperes.	Net Horse-power.	Feed.	Net Amperes.	Net Horse-power.
0 0125	2.5	0.75	0.075	14.	4.1
0.025	4.5	1.33	0.0875	16.5	4.87
0.0375	6.5	1.93	0.100	17.5	5.16
0.050	8.5	2.5	0.125	21.5	6.33
0.0625	11.5	3.4	.....	....	....

The motor and counter-shaft were first run idle, and the power required for this was carefully noted. Then the machine belt was thrown in, and it was found that when running the machine idle, there was practically no increase in the power required for the 16-inch shaper, except at the point of reversal, when there was a rise of about one-half ampere. On the 24-inch shaper, one-half ampere or about one-seventh horse-power was required to run the ram on the forward stroke, and nearly two amperes at the moment of reversal. Readings were taken at the highest point reached by the needle of the meter on each stroke. In the accompanying tables, the results of the tests are given for cuts one-half inch deep made in cast iron. The net amperes and net horse-power given in the tables give the figures actually required for taking the cut. In the case of the 24-inch crank shaper, one-half ampere should be added to the net amperes to obtain the maximum amperes required for running the machine on the forward stroke.

It is rather surprising that so high a horse-power is required for driving the coarse-feed cuts, but considering the reciprocating motion of the machine, a somewhat smaller motor can be used than what would be indicated by the net horse-power, because first-class standard motors provide for a momentary over-load of 100 per cent. Besides, it is doubtful if many shops would attempt to take cuts with as coarse feed as that indicated by the last items in each table, although the shapers being tested are guaranteed to withstand cuts with this feed indefinitely, if properly cared for.

TESTS ON 24-INCH CRANK SHAPER.

Depth of cut, ½-inch.

Feed.	Net Amperes.	Net Horse-power.	Feed.	Net Amperes.	Net Horse-power.
0.025	5.5	1.6	0.150	22.5	6.6
0.050	8.5	2.5	0.175	25.0	7.4
0.075	11.5	3.4	0.200	26.5	7.8
0.100	15.0	4.4	0.250	31.0	9.1
0.125	20.0	6.0	...	....	...

Some of the interesting things noted from the two tables given are that the horse-power for any given cut is about the same on the two sizes of machines, and that the horse-power advances in nearly direct ratio to the feed. The first fact is interesting as indicating that shapers of different sizes, when properly built, will work with about the same efficiency within their respective capacities, and the latter fact is of interest because it indicates that there is little additional loss from binding action and friction, even on the heavy cuts, in shapers properly designed and rigidly built for the work for which they are intended. This is all the more remarkable, as the shaper is particularly subjected to severe twisting stresses, due to the great amount of over-hang inherent in its construction.

* * *

MACHINERY SWINDLER IN THE SOUTH.

The swindler, "Eddie Ward," whose operations in the West were mentioned in the August, 1908, issue of MACHINERY, is now working in the South. He still represents himself as agent for J. J. McCabe, 30 Church Street, New York, and was last reported at West Point, Miss., and Talladega, Ala. At West Point he collected from Mr. F. A. Bentley of the West Point Machine Co., a deposit on a trade he proposed, which seemed very profitable to the concern. The Talladega Foundry & Machine Co. gave Ward a deposit on the purchase of a Hendey lathe, which was represented as belonging to McCabe, and as being ready for shipment from some point in Mississippi. Mr. McCabe informs us that he has no traveling men whatsoever at present in the South or West, as he is represented in these sections by prominent machinery dealers.

* * *

The last reports of the exports of machine tools from Great Britain indicate a healthy increase in trade. The exports during the month of December last year were the highest for any month during the year. The value of the exports of machine tools for this month amounted to about $575,000, and the value of the imports during the same period, to about $40,000.

FORMULAS FOR MACHINE SCREW BUTTON OR SPLIT DIES.

THOMAS J. NORTON* AND DOUGLAS T. HAMILTON.

Upon the adoption by the American Society of Mechanical Engineers of new standards for machine screws, it occurred to the authors to investigate a means of standardizing the proportions of button dies, so as to admit of a uniformity of manufacture and to eliminate all trial and error methods in the laying out of these dies. The method described has as its basis the maximum root diameter and outside diameter of the basic screw to be threaded. These are the only fixed quantities; all proportions of the die are derived from these two fundamental dimensions.

The dies are made with three cutting edges or teeth set slightly ahead or in advance of the center. The ratio of land to space has been taken as one to two. This relation has been found to work most satisfactorily in practice, especially in the present case for machine screw dies of small size. The advance ahead of the center, necessarily a small dimension to lay off, is taken care of by the general method employed.

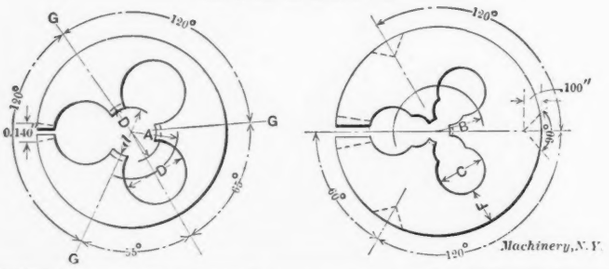
Let D = outside diameter of basic screw,

d = maximum root diameter of basic screw,

A = distance of first clearance hole of diameter D from center of die blank.

Take any three axes G on the die blank at 120 degrees to one another. Lay off the center lines of the clearance holes to make angles of 55 degrees with these axes. The distance

PROPORTIONS FOR A. S. M. E. STANDARD SCREW THREAD BUTTON DIES, STANDARD SIZES.



Outside Diameter of Basic Screw and Threads per inch D, inches.	Max. Root Diameter of Basic Screw d, inches.	A inches.	Outside Diameter of Die Blank, inches.	B inches.	C inches.	Thickness of Die Blank, inches.	F inches.
0.060–80	0.0438	0.0432	13/16	0.1853	0.2543	0.2187	3/32
0.073–72	0.0550	0.0529	13/16	0.1918	0.2414	0.2187	3/32
0.086–64	0.0657	0.0626	13/16	0.1983	0.2284	0.2187	3/32
0 099–56	0.0758	0.0721	13/16	0.2046	0.2157	0.2187	3/32
0.112–48	0.0849	0.0814	13/16	0.2109	0.2031	0.2187	3/32
0.125–44	0.0955	0.0910	13/16	0.2174	0.1902	0.2187	3/32
0.138–40	0.1055	0.1005	13/16	0.2237	0.1775	0.2187	3/32
0.151–36	0.1149	0.1098	13/16	0.2301	0.1649	0.2187	3/32
0.164–36	0.1279	0.1199	1.000	0.1898	0.2453	0.2500	3/32
0.177–32	0.1364	0.1291	1.000	0.1961	0.2328	0.2500	3/32
0.190–30	0.1467	0.1386	1.000	0.2024	0.2201	0.2500	3/32
0.216–28	0 1696	0.1582	1.000	0.2155	0.1940	0.2500	3/32
0.242–24	0.1879	0.1767	1.000	0.3217	0.1690	0.2500	3/32
0 268–22	0.2090	0.1961	1.000	0.3347	0.1431	0.2500	3/32
0.294–20	0.2290	0.2150	1.000	0.3474	0.1177	0.2500	3/32
0.320–20	0.2550	0.2351	1.000	.....	.....	0.2500	.....
0.346–18	0.2738	0.2538	1.250	0.4308	0.2009	0.3125	3/32
0 372–16	0.2908	0.2722	1.250	0.4482	0.1660	0.3125	3/32
0.398–16	0.3168	0.2832	1.250	0.4570	0.1485	0.3125	3/32
0.424–14	0.3312	0.2902	1.250	0.4637	0.1350	0.3125	3/32
0 450–14	0.3572	0.2938	1.250	0.4686	0.1249	0.3125	3/32

A of the centers of the clearance holes from the center of the die blank along these 55-degree lines is given by the formula

$$A = \frac{d}{2}\cos 40 \text{ deg.} + \sqrt{\left(\frac{D}{2}\right)^2 - \left(\frac{d}{2}\sin 40 \text{ deg.}\right)^2}$$

From these centers, by drawing circles of diameters equal to the outside diameters of the basic screw, the correct relation of land to space is immediately obtained, and the necessary advance ahead of the center assured. For the larger size dies with a single clearance hole, the die blank is now ready for drilling and tapping.

* Address: Northern Electric & Mfg. Co., Ltd., 814 Notre Dame St., West, Montreal, Canada.

In the case of the smaller dies, where two clearance holes are necessary some difficulty was experienced in obtaining a general method, inasmuch as the outside diameter of the die blank is constant for several sizes. This must be so on account of the die holder.

The diameter C of the second clearance hole is given by the formula

$$C = \frac{H}{2} - \left\{A + \frac{D}{4} + F\right\}$$

where H = outside diameter of die blank,

F = width of metal between outside of die blank and edge of clearance hole.

The thickness F of the outer skin of the die may be taken to suit different practice; in the present case it was taken as 3-32 inch.

PROPORTIONS FOR A. S. M. E. SPECIAL SCREW THREAD BUTTON DIES, SPECIAL SIZES.

Outside Diameter of Basic Screw and Threads per inch D, inches	Max. Root Diameter of Basic Screw d, inches.	A inches.	Outside Diameter of Die Blank, inches.	B inches.	C inches.	Thickness of Die Blank, inches.	F inches.
0.073–64	0.0527	0.0525	13/16	0.1917	0.2417	0.2187	3/32
0.086–56	0.0628	0.0620	13/16	0.1980	0.2290	0.2187	3/32
0.099–48	0.0719	0.0713	13/16	0.2043	0.2165	0.2187	3/32
0.112–40	0.0795	0.0803	13/16	0.2104	0.2042	0.2187	3/32
36	0.0759	0.0794	13/16	0.2100	0.2051	0.2187	3/32
0.125–40	0.0925	0.0903	13/16	0.2170	0.1910	0.2187	3/32
36	0.0889	0.0896	13/16	0.2167	0.1917	0.2187	3/32
0.138–36	0.1019	0.0997	13/16	0.2234	0.1783	0.2187	3/32
32	0.0974	0.0987	13/16	0.2229	0.1793	0.2187	3/32
0.151–32	0.1104	0.1089	13/16	0.2296	0.1659	0.2187	3/32
30	0.1077	0.1083	1.000	0.2761	0.2602	0.250	3/32
0.164–32	0.1234	0.1190	1.000	0.2831	0.2462	0.250	3/32
30	0.1207	0.1184	1.000	0.2828	0.2468	0.250	3/32
0.177–30	0.1337	0.1285	1.000	0.2895	0.2335	0.250	3/32
24	0.1229	0.1262	1.000	0.2863	0.2358	0.250	3/32
0.190–32	0.1494	0.1391	1.000	0.2964	0.2196	0.250	3/32
24	0.1359	0.1364	1.000	0.2951	0.2223	0.250	3/32
0.216 24	0.1619	0.1565	1.000	0.3084	0.1957	0.250	3/32
0.242–20	0.1770	0.1745	1.000	0.3206	0.1712	0.250	3/32
0.268–20	0.2030	0.1947	1.000	0.3340	0.1445	0.250	3/32
0.294–18	0.2218	0.2134	1.000	0.3466	0.1193	0.250	3/32
0.320–18	0.2478	0.2337	1.000	0.3600	0.0925	0.250	3/32
0.346–16	0.2648	0.2519	1.250	0.4348	0.1928	0.3125	3/32
0.372–18	0.2998	0.2740	1.250	0.4491	0.1642	0.3125	3/32
0 398–14	0.3052	0.2903	1.250	0.4605	0.1414	0.3125	3/32
0.424–16	0.3428	0.2916	1.250	0.4649	0.1336	0.3125	3/32
0.450–16	0.3688	0.2942	1.250	0.4690	0.1245	0.3125	3/32

The distance B of the second clearance hole from the center of the die blank is given by the formula

$$B = \frac{H}{2} - \left\{\frac{C}{2} + F\right\}$$

It will be seen from the accompanying tables of proportions that B and C are given in nearly all cases. In many of these it is impossible to drill C without a jig, in which case the second clearance hole may be filed. These tables give all the proportions derived from the foregoing method for laying out button dies for the A. S. M. E. standard and special machine screws.

Universal Application of Formulas.

The formulas may be applied to any case whatsoever, regardless of the number of flutes and relation of land to space. For example, they may be used for dies with say six lands.

Let n = number of lands,

α = land ratio,

β = space ratio,

then the formula in its general application will be

$$A = \frac{d}{2}\cos x + \sqrt{\left(\frac{D}{2}\right)^2 - \left(\frac{d}{2}\sin x\right)^2}$$

where $x = \dfrac{360}{n \times (\alpha + \beta)} \times \dfrac{\beta}{2}$ degrees

For a case of four lands with a ratio of land to space of 2 to 3

$$x = \frac{360}{4(2+3)} \times \frac{3}{2} = 27 \text{ degrees.}$$

The angle that the clearance hole makes with the axis of the teeth would be $x - 5$ or 22 degrees. This gives the necessary advance ahead of the center. For a second clearance hole the method is the same as outlined above.

In order to insure a good cutting edge on the die, the first clearance hole is lapped after hardening. This proves very satisfactory.

* * *

HOB GRINDING ATTACHMENT FOR THE PLANER.

To avoid the necessity for the constant attendance of an operator in sharpening hobs, an automatic arrangement for this work has been rigged up by Mr. H. C. Gilman, shop superintendent of the Philadelphia Gear Works, Philadelphia, Pa. This attachment is mounted on an old 16-inch planer and employs a very simple arrangement of mechanism for the necessary movements, automatically indexing the hob and feeding the wheel. Fig. 1 shows the attachment at work, and Fig. 2 is a diagram showing the arrangement of the mechanism.

Special index centers are provided. Indexing spindle *A* carries two dials. One of these, *B*, has ratchet teeth for indexing the spindle, while the larger one, *C*, is provided with notches for locking the spindle after the indexing. A "tip-up" dog *D* with a taper face is mounted on a bracket *E* fastened to the rear side of the bed. This dog engages the rounded end of a bar *F*, which slides in guides in the front face of the head-stock casting *G*. As the table starts on the forward stroke, the rounded end of *F* runs up the inclined face of the dog *D* pushing *F* to the right. The locking bolt *H*, clamped to *F* by the support shown, is thus released from

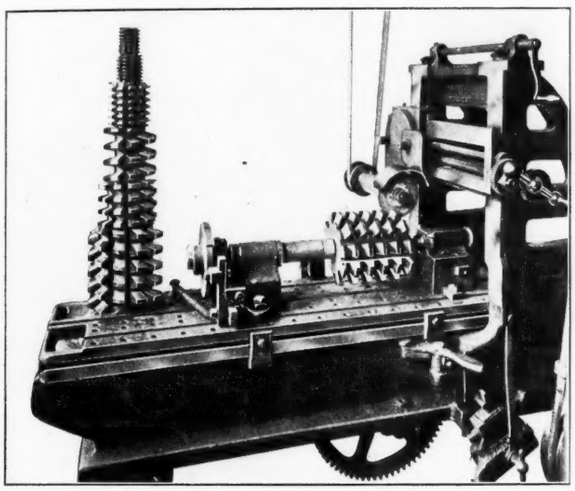


Fig. 1. Simple Planer Attachment for Sharpening Hobs.

the notch in locking dial *C;* and a counter-weighted pawl *J*, also pivoted to *F*, indexes the spindle by its action on dial *B*. When the end of *F* drops over the face of the dog *D*, the bolt *H* flies into place in the locking disk, holding the spindle in position for the next stroke of the wheel, while pawl *J* is brought back into engagement with the next tooth of ratchet *B*. This retraction of bar *F* is effected by spring *K*. On the backward stroke, as shown at the right of Fig. 2, dog *D* tips up to the position indicated by the dotted lines, allowing *F* to pass in this direction without interference.

The automatic feed arrangement is almost ridiculously simple. The feed-screw has an end movement of about 1/64 of an inch between its thrust collars. This end movement is taken up toward the right by a spring suitably placed at the left hand end. In setting up the machine for a grinding operation, the wheel is fed up against the face of the teeth until this slack is all taken up. When the machine is once started, it will continue to cut until 1/64 of an inch has been removed. On the first few cuts the end teeth are rounded, of course, but as the work progresses, the face is finished straight across. This machine has proved to be of such value that it is left permanently rigged as shown, and is constantly in demand.

CHECK SYSTEM FOR TOOL-ROOMS.

GEO. D. HADUN.

In order to determine the best system for keeping track of the tools lent to the workmen from the tool store-room, three methods, as outlined in the following, were tried in a well-known shop employing about five hundred hands.

With the first method, each man had a number of checks in his own keeping, and one of these was deposited with the store-keeper for each tool borrowed. This check was hung near the space previously occupied by the tool lent, in the usual manner.

As the foregoing method was somewhat unsatisfactory, all checks were collected from the workmen, and kept on a

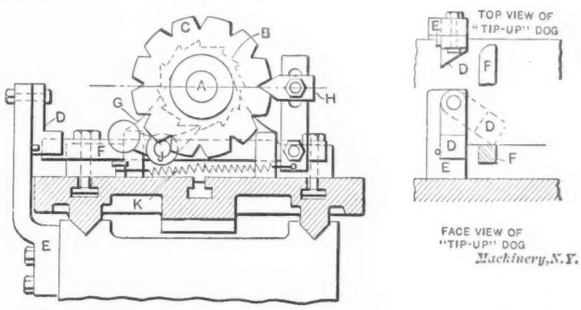


Fig. 2. Diagrammatical Sketch of the Mechanism shown in Fig. 1.

board in charge of the store-keeper, from which they were removed and hung, as in the first case, when tools were borrowed.

The second method also proved unsatisfactory and was abandoned. Loose printed slips of paper were then distributed in suitable boxes about the works, and each man was obliged to write on a slip his pay roll check number, what tool he required, the date, and his signature. This slip was then handed to the store-keeper in receipt for the tool borrowed, and the slips filed away in card cases, in numerical order, back of guide cards arranged to suit the various classes of tools, such as taps, reamers, cutters, etc. When the tool was returned, the slip was handed back to the man to be destroyed.

The first two methods are the ones commonly used where there is a tool store-room, some firms preferring one, and some the other. The first method was abandoned by the shop in question after a twelve months' trial, because the men could not, or would not, take care of their checks, and if one of these were lost, there was nothing to prevent its being used by another man, if he found it, for it was impossible for the store-boys to know whether every man handed in the proper check or not. Again, checks would occasionally get misplaced, causing considerable trouble. Various means were taken to prevent these troubles, but without success, and finally the second method was adopted. This was also given a twelve months' trial, and, if anything, proved rather worse than the first, as the store-boys misplaced the checks, omitted to replace them on the board when tools were returned, or, if there was more than one check on the hook, sometimes took off the wrong check. I do not think, however, that these boys were any worse than the average. No doubt some of the men contributed to the trouble by losing or mislaying a tool, and then claiming that it had been returned and that the boy had forgotten to replace the check on the board. The third method has now been in use about three months, and, so far, it has proved more successful than either of the other two. Of course, it takes longer to write out the slips, and there is a slight expense for paper, printing, etc., but this expenditure is more than offset by the satisfactory way in which the system works.

Perhaps some who read this may be inclined to say that the first system is the best, and greater firmness should have been exercised in order to keep it going. Possibly if I had not tried all three methods I should be inclined to say the same, but all will agree that with the same men, and under similar conditions, the system which causes the least trouble is the system to adopt, and this was done. Have any of your other readers had a similar experience?

VALVE GRINDING MACHINE.

J. F. MIRRIELEES.*

A machine for grinding gas engine valves, designed to grind the particular style of valve shown in Fig. 1, is illustrated in Fig. 2. Previous to designing this machine, the best practice in valve grinding, in general, as applied to this style of valve, in particular, was thoroughly investigated; and from a series of experiments the following facts were established: The grinding speed should not be less than 50 feet per minute, nor more than 75 feet per minute; the valve must be rotated alternately in both directions, and one and a fractional part of a revolution each way is sufficient and even better than two or more revolutions; the valve must be raised clear of the seat and allowed to rotate freely; carborundum is the best abrasive for cutting, and emery flour the best for finishing.

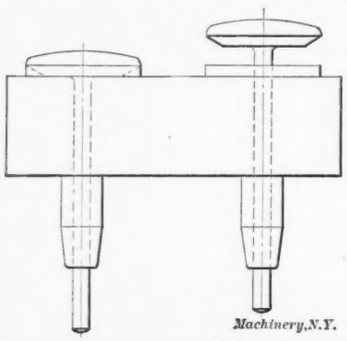


Fig. 1. Type of Valves for which the Machine shown in Fig. 2 was designed.

The necessity for reversing the motion and lifting the valve is much more pronounced when carborundum is used than when emery. The particles of the former seem to have a greater tendency to imbed themselves in the metal, and if this tendency is encouraged by rotating continuously in one direction, the particles become permanently imbedded, and grooves in the seat are the result. If the valves are not raised occasionally to allow the abrasive to distribute itself, the grinding will be uneven. The machine here illustrated covers these points. When valves are to be ground with it, the seats, the style of which is shown in Fig. 1, are placed on the table of the machine. They are not secured, however, but allowed to center themselves at all times. The forks or drivers *A* grip the valves by means of suitable holes in the latter, and the valve stems extend through the table and directly above the lifter levers *C*. The variation in the length of the stems of the different size valves is regulated by means of parallel strips of thickness sufficient to make all stems extend through the table the same distance. Power is transmitted to the machine by means of a 2-inch belt on an 8-inch pulley which runs about 150 revolutions per minute. The power is then transmitted through a train of gears, which connects with the segment *M* plainly shown in the end elevation, thus giving a reversing motion to the shaft *D*. From this shaft through bevel pinions and gears, the spindles *E* are driven. The latter are held in quills *F* which, in turn, are held in heads *G* which are adjustable horizontally along the cross-rail *H*. The vertical adjustment of the spindles is automatic. Each spindle is splined in its quill, and the adjustment for different heights of work is made by spiral springs located above the spindles. The grinding pressure exerted is likewise regulated automatically. The larger seats, with larger valves and longer stems, must be raised from the table on strips so that the stems extend through just enough to clear the lifting levers *C*; consequently the spiral springs in the quills are compressed and press harder on the valves. Under the lifting levers *C* runs the shaft *I* upon which are located the cams *J* employed to actuate the lifting levers, which, in turn, lift the valves from their seats. The cams are placed quartering around the shaft so that but one valve raises at a time. The shape of the cams causes the valves to raise quickly, which, after revolving free momentarily, drop hard to their seats. The cam shaft is driven by means of sprockets and chains from the hub of the driving pulley. As will be seen by referring to the illustration, the lifting levers *C* may be operated by hand when desired. In order that work on any of the spindles may be stopped without interfering with the others, the little chains *K* are attached to the quills, and suitable button-head screws *L* inserted in the spindles, which, when raised, may be caught and held up by the chains.

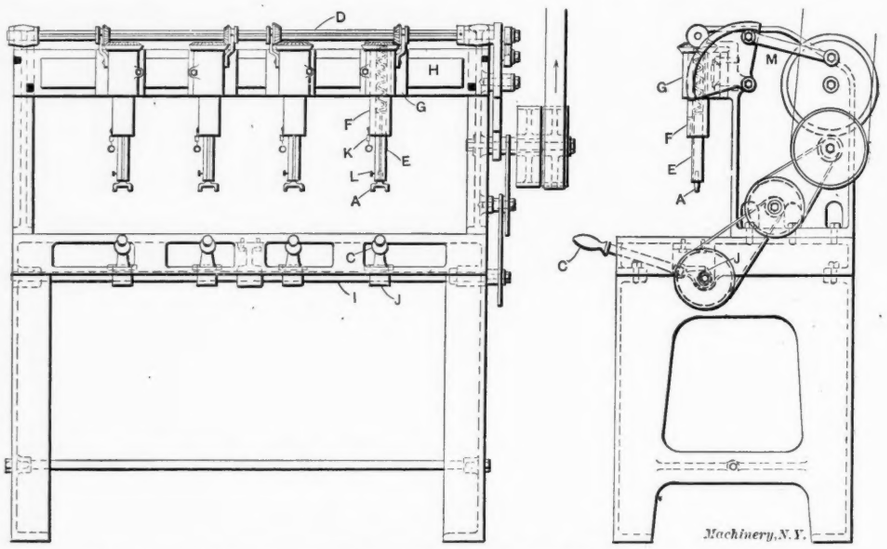


Fig. 2. Valve Grinding Machine which automatically Reverses the Movement of the Valves, and occasionally lifts them from their Seats.

* * *

The Maxim silencer or muffler for guns which has been referred to in recent numbers of MACHINERY was given a public test in New York, February 8. The silencer was applied to a variety of guns, from the 0.22 caliber to the high power Springfield 0.30 army rifle, and in all cases the efficiency of the device was conclusively demonstrated. The sound of the report was almost entirely eliminated, except in the case of the automatic rifles of the "blow-back" type. With these guns, the escape of gases at the breech made a perceptible report. With the other types of rifles the sound was confined to the whistle made by the bullet in its passage through the air, and its impact on the target. The silencer consists of a thin steel tube about 1½ inch in diameter, and 9 inches long, which is screwed onto the muzzle of the piece. The weight for the heaviest guns is about 11 ounces, and for the lighter ones about 8 ounces. The interior of the tube contains ten or twelve disks, perforated above center with a hole slightly larger than the caliber of the gun. The disks are rolled over into a shape somewhat like the vanes of a turbine water-wheel and cool and dissipate the gases at a low pressure because of the effect of the rotary and centrifugal action. The action is somewhat similar to that of water escaping from a wash basin. When the plug is pulled and the water allowed to flow, it acquires a circular action which may become so rapid that the water goes slowly through the hole and a clear space exists in the center through which air is drawn. The flow of the water is impeded by its rotary motion and the more rapidly it rotates the slower it escapes. Thus it is in the silencer; the gases are expanded and permitted to escape to the atmosphere only when the low pressure is attained. Perhaps the most useful purpose that the device will be applied to will not be as a silencer of guns but rather as a muffler for that useful worker, the gas engine.

* * *

You can tell a salesman by the way he sells his own services.—*Common Sense.*

* Address: 3765 Rosedale Ave., Cincinnati, Ohio.

STOVE BOLT TAPS.

S.

In the various articles that have appeared in MACHINERY from time to time regarding taps, nothing has been said about stove bolt taps, and as these taps, and likewise the bolts and screws, are provided with a form of thread which is an interesting example of a mongrel United States standard form of thread, perhaps some of the readers of MACHINERY would be interested in a description of them.

The thread has an angle of 60 degrees, with flat top and bottom which are equal in width. The width of the flats is wider than for the U. S. standard thread, being in some cases nearly one-quarter the pitch. The widths of flats being so wide as compared with the pitch, makes the thread shallow in comparison with other screw thread systems.

Below are given the widths of tools for the various sizes, and though the tools given are a little narrow in some cases, for reasons explained later, it will be shown that they are

STOVE BOLT HAND TAPS.

Nominal Size.	Actual Diameter, Inches.	Root Diameter.	No. of Threads per Inch.	Total Length.	Length of Thread.	Length of Shank.	Size of Square.	Length of Square.	Approximate Machine Screw Tap Size.
5/32	0.167	0.134	28	2 1/8	1 3/16	1 5/16	1/8	7/32	8
3/16	0.200	0.157	24	2 1/4	1 5/16	1 3/32	5/32	1/4	10½
7/32	0.227	0.180	22	2 5/16	1 7/16	1 1/16	5/32	9/32	12½
1/4	0.260	0.203	18	2 1/2	1	1 1/4	3/16	5/16	15
5/16	0.317	0.2585	18	2 11/16	1 1/8	1 9/16	1/4	5/16	19½
3/8	0.352	0.287	16	2 15/16	1 1/4	1 11/16	1/4	3/8	22

near enough for all practical purposes. However, if one wishes and has the proper instruments for measuring the widths of flats, the tools can be ground to the widths given. Where there has been any choice in the selection of the nearest U. S. standard threading tool, the one that is narrower than the width of the flat has been chosen, so that the flat on top of the tap would be wider than in the bottom, that it might be certain to take out enough material from the nut or tapped hole, to insure the bolt or screw turning easily. Should one, however, be making a hob tap to make a die for making stove bolts, it would be well to follow the dimensions given.

Stove bolt taps are made 0.004 to 0.005 inch larger than the screw, so that the nuts may be a loose fit, a fit that would not be tolerated on any of the standard screw-thread systems for bolts and nuts. For this reason, the few ten-thousandths inch the threading tools are narrower than the table calls for would make but little difference in the fit of the nut.

NUMBER OF THREADS, WIDTH OF FLAT, AND THREADING TOOLS FOR STOVE BOLT TAPS.

Nominal Size of Tap.	Pitch.	Width of Flat.	Nearest U. S. Standard Threading Tool to Cut Thread.
5/32	28	0.0083	16 threads U. S. which is 0.0078 inch wide.
3/16	24	0.0084	
7/32	22	0.0092	14 threads which is 0.0089 inch wide
1/4	18	0.0113	11 threads which is 0.0114 inch wide
5/16	18	0.0109	12 threads which is 0.0104 inch wide
3/8	16	0.0125	10 threads which is 0.0125 inch wide

As mentioned, the taps are made oversize, and the nominal sizes are smaller than the actual sizes except in one case, the three-eighths, where the actual size is nearly one-thirty-second inch smaller than the nominal size.

It is obvious that special screws or bolts might become oversize before the days of micrometer calipers and screw-thread micrometer calipers, for unless the working gages are looked after carefully, and there is a master gage to which to refer these working gages occasionally, they will become worn, and so allow the screws to become larger than they were originally intended to be. This is probably what happened to stove bolts years ago.

Another example of this same idea is the so-called 41/64-inch shanks for twist drills, used principally by blacksmiths at the present time. These shanks instead of being 0.6406 inch, the decimal size of 41/64 inch, are 0.647 inch, which is about 0.006 inch oversize.

It is customary to make stove bolt hand taps with shanks the same diameter as the actual size of the tap, and the accompanying table has been figured to that end.

* * *

NEW HIGH-SPEED STEEL.

In an address delivered before the Royal Institution, Prof. Arnold of Sheffield University said that within a year there would be on the market a British steel with quadruple the cutting power of any now known. What. Prof. Arnold referred to was a product of the Continental Steel Works (Jonas & Colver, Ltd.) at Sheffield, just discovered and named "Novo Superior." Mr. B. W. Winder, the manager of the works, in an interview said the discovery was the outcome of litigation instituted by the Bethlehem Steel Company, which claims the patent rights on air-hardened high-speed steel. Experiments with a view to rendering themselves independent of the American claims, conducted by the Continental works, resulted in the discovery. A tool made of the old high-speed steel working on hard material at Sheffield had to be ground five times a day. A similar tool of the new process steel worked with one grinding for a day and a half, and was still sharp. The American agents for Jonas & Colver, Ltd., are Hermann Boker & Co., New York.

A later report states that the new steel can be readily annealed and that no other high-speed steel has any advantage over it in the matters of annealing, forging or non-susceptibility to overheating. The makers recently tried a severe experiment. A tool made of the new steel was hardened seventeen times in cold water without showing a sign of a crack. It can be hardened also in oil, paraffin, or air blast. Prof. Arnold stated that it is an absolutely new departure in metallurgy to have obtained a water-hardened steel which will work for a long time with a keen edge at a low red heat when cutting hard steel. He added that in all probability every high-speed steel manufacturer in the country soon would be making the same steel, as the secret could not be long retained. From this statement it might be inferred that the process of manufacture is essentially simple.

* * *

TAYLOR-WHITE HIGH-SPEED PATENTS INVALID.

The United States Circuit Court of the District of New Jersey recently handed down a decision in the suit brought by the Bethlehem Steel Co. two years ago against the Niles-Bement-Pond Co. for infringement under the Taylor-White high-speed steel patents, deciding that the nineteen claims of the plaintiff were invalid. The testimony covered about 5,000 typewritten sheets and reviewed much of the history of steel making from the time cast steel was first made down to the discovery of the Taylor-White process. It evidently was shown to the satisfaction of the court that the process was not essentially a new one and that the testimony of important witnesses was biased. The case was reopened last November and then it was shown from certain copy books or other records of the Bethlehem Steel Co. that the principal inventor had received a valuable concession in consideration of testimony favorable to the Bethlehem Steel Co., to which the patent had been assigned. The court severely scored the witnesses and declared that all the claims made by the Bethlehem Steel Co. were invalid.

* * *

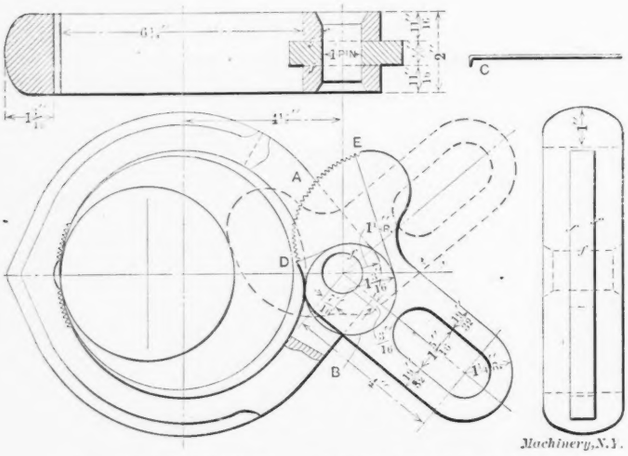
In its famous decision on eighty-cent gas legislation, the Supreme Court of the United States made an important ruling in regard to the value of good will. It is to the effect that good will is not a concrete thing that can be capitalized in a city where a public utility corporation has monopoly of its particular business. The decision virtually limits the value of the franchise to the allowable capitalization at the time the franchise was granted. The growth of a city and the increased earning power of the monopoly cannot be employed as excuses to increase the capitalization. A city's inhabitants are entitled to the same service for less cost when it can be shown that the increase of population enables the public utility corporations to produce much cheaper than before.

LETTERS UPON PRACTICAL SUBJECTS.

Articles contributed to MACHINERY with the expectation of payment must be submitted exclusively.

LATHE DRIVER FOR ROUND STOCK.

The accompanying engraving shows an excellent style of dog or driver which has been found by use to remedy the difficulties that often occur when driving large, round work in the lathe, which requires heavy cuts and high speed. The reader can readily see without a lengthy explanation, that it would be impossible for this dog to release its grip, for the larger the cut the more the teeth will bite. It is made of a



Dog adapted to Driving Large Cylindrical Work in the Lathe.

low grade of tool steel, and the teeth are given a chisel temper, so that they will not bend or break when the strain comes. To generate the curve of the toothed surface *A*, secure a cylindrical piece having a diameter equal to that of the generating circle *B*, and locate it concentric with the generating circle. Obtain a piece of small wire, and bend and sharpen one end for a scriber, as shown at *C*. Wind the wire around the cylindrical piece, and, beginning at *D*, scribe the curve to a point *E*, as the wire is unwound. Those who have experienced difficulties in this line will be well repaid by giving this driver a trial. R. F. S.

GAGES FOR ACCURATELY SIZING BEVEL GEAR BLANKS.

In the manufacture of our sensitive high speed universal milling attachment, we use quite a number of small bevel gears, and as the gears sometimes run at a high speed, it

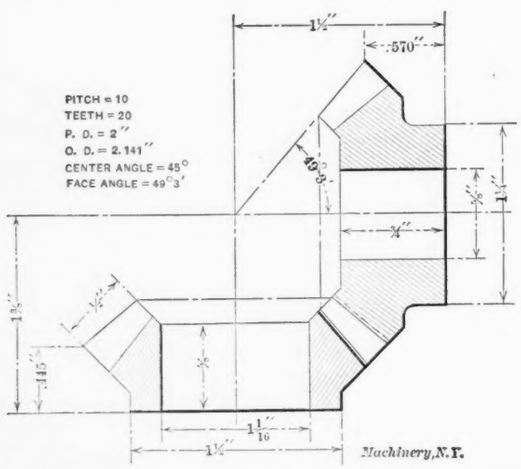


Fig. 1. Miter Gears for which Gages in Figs. 2 and 3 were made.

is necessary that they should be accurately planed. To facilitate the sizing of the blanks, the writer designed the gages illustrated in Figs. 2 and 3, which were made to gage the blanks for the miter gears shown in Fig. 1. As these are miter gears, the face angles are, of course, the same, but it will be noticed that one has a longer hub than the other, which necessitates making two gages. The parts of the attachment in which these gears run are very accurately machined with reference to the distance from the hub of one gear to the center of the other, so that if the blanks are correctly sized and cut, they will go in place and run properly without fitting.

The following method was used to obtain the gage dimensions. We will take the gage shown in Fig. 2, which is used for sizing the gear with the long hub.

The distance from the hub of this gear to the center of the other shaft is 1½ inch, and the face angle is 49 degrees 3 minutes. The triangular opening in the gage should correspond exactly to these dimensions. To obtain this result the size of a circular plug gage which would just pass through the triangular opening, was determined as follows.

It is evident from Fig. 2 that as the triangle $A\,G\,B$ is an isosceles triangle, if a circle be inscribed in it, the center of the circle must be somewhere on the line $C\,D$ which bisects the angle $A\,G\,B$ and the line $A\,B$. It must also be somewhere on the line $A\,E$ which bisects the angle $G\,A\,B$; therefore it must be at the point where these two lines intersect. $G\,F = 1.5$ inch; angle $A\,G\,F = 49$ degrees 3 minutes; therefore $A\,F = 1.5 \times \tan$ 49 degrees 3 minutes $= 1.5 \times 1.1524 = 1.7286$. One-half of the angle $G\,A\,F = 20$ degrees 28½ minutes; $O\,F = A\,F \times \tan$ 20 degrees 28½ minutes $= 1.7286 \times 0.37339 = 0.6454$ inch, which is the radius of the inscribed circle; $2 \times 0.6454 = 1.2908$ inch, diameter of inscribed circle or

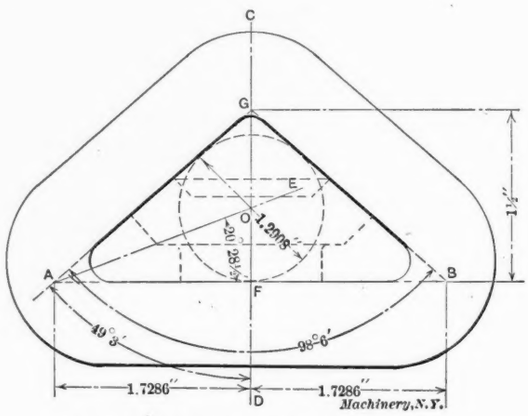


Fig. 2. Gage for Miter Gear with Long Hub in Fig. 1.

plug gage. The same process was, of course, used to obtain the size of the gage shown in Fig. 3. The gages were made from ¼-inch cold rolled sheet steel; larger ones may be made from thicker material. The outside of the gages was worked out with a hacksaw and smoothed up with a file. The inside was drilled out, leaving about 1/16 inch on each side to be finished with a universal milling attachment. The gages were strapped to the face-plate of a Brown & Sharpe 60 to 1 index head while being milled out, the head being set at 90 degrees; the gage rested on three parallels to allow the end mill to get into the work without danger of milling into the head, and also to assist in using the plug gage. The job was set so as to bring the side $A\,G$ in line with the table travel, and that side was finished down to the line with a small end mill; we now turn the head 98 degrees 6 minutes, which with a 60 head and 60 hole plate, is 16 turns and 21 holes for the index pin (one turn equals 6 degrees, and with the 60 hole plate 1 degree or 60 minutes equals 10 holes, and therefore 1 hole equals one-tenth of 60 minutes or 6 minutes.

This brings the side $G\,B$ in line to be milled. After it has been finished down to the line we turn the index pin 6 turns and 49½ holes farther, which brings the side $A\,B$ in line to be milled, and this side is worked out until it is a good fit on the plug gage.

The ½ hole in the last indexing was guessed at, and this proved to be accurate enough, for when a blank had a good smooth finish on the face and was sized so that it would just pass through the gage without binding we could not see light through anywhere between the blank and the gage.

The indexing, of course, was just the same for the gage shown in Fig. 3, as the only difference in the two gages is the size of the opening.

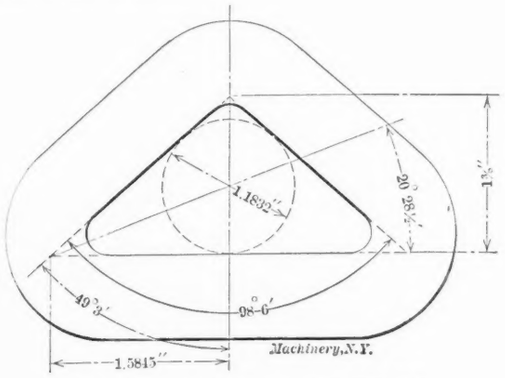


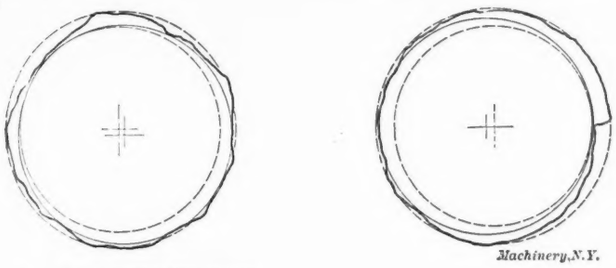
Fig. 3. Gage for Miter Gear with Short Hub.

We have made up quite a number of these gages and they have given excellent satisfaction, and it would seem that this same scheme might be used to advantage in a good many instances and in various ways.

Syracuse, N. Y. GEORGE. D. PORTER,
The Porter-Cable Machine Co.

TRUING ROUGH WORK.

There is a fundamental error in the conventional method of truing rough work, such as forgings or castings, especially large ones, in the lathe. There are two requisites, either of which may determine whether the piece is true enough. First, it is desirable that the point of the tool should get beneath the scale on the first cut, and if the piece runs out too much, the point of the tool will not reach the low spots. This dulls



Diagrams showing why Work should be trued by the Low rather than by the High Spots.

the tool and it will probably be necessary to run the lathe at a slower speed. In the second place, the casting or forging may be barely large enough to finish to the desired size, and therefore requires to be trued accurately. The usual method is to hold a piece of chalk close enough to the work, as it revolves, to touch the high places. The work is then adjusted or re-centered, and tried repeatedly until the chalk will touch opposite points, and, perhaps, additional points between these. The result is that the highest points are running true, and when they are turned off it is the low spots that run out and cause the trouble.

What is needed is a method that will true the work by the low spots, instead of by the high ones. To do this, place a tool in tool-post, parallel to the ways and say an inch from the work. Then turn the work a little at a time and measure from it to the tool until the spot farthest from the tool is found. This is, of course, the low spot, and we shall assume, for example, that it is 7/16 of an inch farther from the tool than the opposite side. Hold a scale against this low place and adjust the work until it has moved one-half of the distance it is out which, in this case would be 7/32 of an inch. Repeat this operation until the low spots all measure practically the same. The piece is then trued so that it will clean up to the best advantage. If the work is long, it is better to test both ends and the middle. When the lowest spot or depression is found, it is well to mark the place and then when the piece is ready to be turned, set the tool by this low spot and note the position of the feed handle. Then when setting the tool for the first cut, it may be adjusted so that it just cleans the entire surface of the work. On a long forging that is sprung, such as a crank-shaft, this method will show whether it can be turned to size without straightening.

Wonalancet, N. H. CHARLES E. BURNS.

ATTACHMENT FOR MILLING HALF CIRCLES IN DROP-FORGE DIES.

In the engraving, Fig. 1, is shown an attachment for the milling machine, which is used for milling out circular recesses in dies used in drop forging. It consists of a frame *A* (see Fig. 2), which supports an arbor *B* upon which is mounted a spur gear *C*, which is in mesh with and drives the milling cutter *D*. This cutter is supported between two adjustable spindles *E* the ends of which fit into recesses in its sides, as shown in the detail Fig. 3. When it is desired to remove the cutter, the spindles may be withdrawn by the screws shown. The spur gear shown on the arbor in Fig. 1, will drive cutters for milling any circle from 1¼ to 4 inches in diameter. The gear and cutter seen on the die are for milling circles smaller than 1¼ inch in diameter. Different size cutters may be placed in mesh with the driving gear by loosening the bolts which hold the slides *F* in place and adjusting the latter to the vertical position required. This driving gear is driven by a key and is made of machinery steel and case-hardened. The cutter is shaped somewhat like a spur gear, except that the cutting faces of the teeth

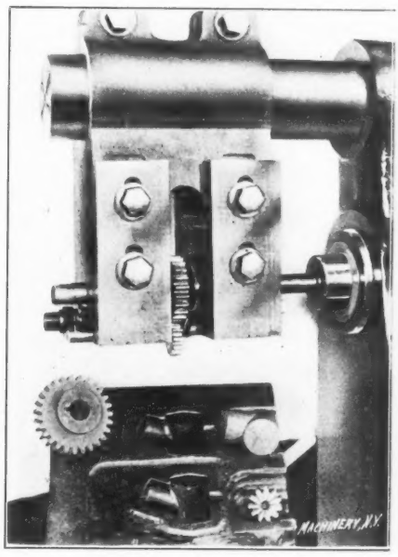


Fig. 1. Attachment for Milling Drop-forge Dies and Example of the Work.

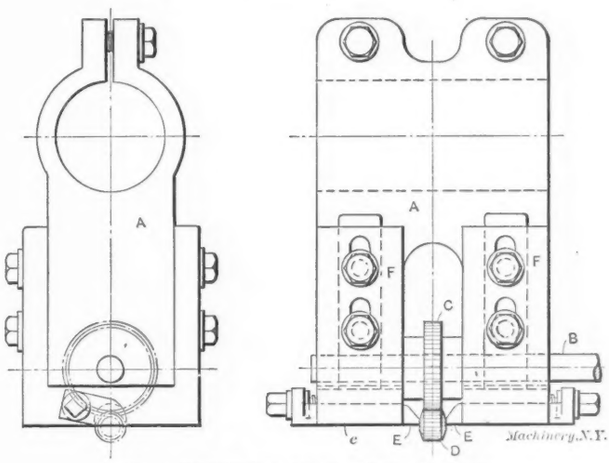


Fig. 2. Elevations of the Die Milling Attachment.

are flat and part of the addenda or tops of the teeth are removed to make them stronger. The outside diameter may be altered, within reasonable limits, to suit the required diameter of the recess. The cutters should have 10 diametral pitch if larger than 0.9 inch pitch diameter, and 14

diametral pitch if smaller. The centers of the circular ends of the spindles *E* are 1/32 inch below the bottom face *e* of the frame so that the center of a circular recess may be milled flush with or slightly below the surface of the die. The die shown in Fig. 1, which is used for forging brackets

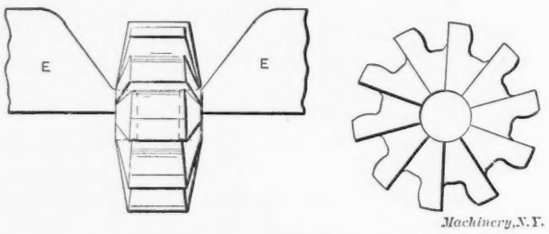


Fig. 3. Enlarged View showing Cutter and Ends of Spindles upon which it revolves.

for bicycle frames, is an example of the work done with this attachment. We have been milling dies in this way for some time and the method certainly "knocks the spots" out of chipping and filing. FRED TERRY.

West Toronto, Canada.

BINDER FOR PRESERVING ARTICLES OF SPECIAL INTEREST.

The illustrations, Figs. 1 and 2, show a binder or holder which will be found convenient for preserving the various articles on special tools, processes, etc., published in MACHINERY, which I think will be appreciated by many mechanics wishing to keep these articles ready for reference. Fig. 1 shows a view of the closed holder, which is simply an old ledger book with all the leaves cut out to within about one

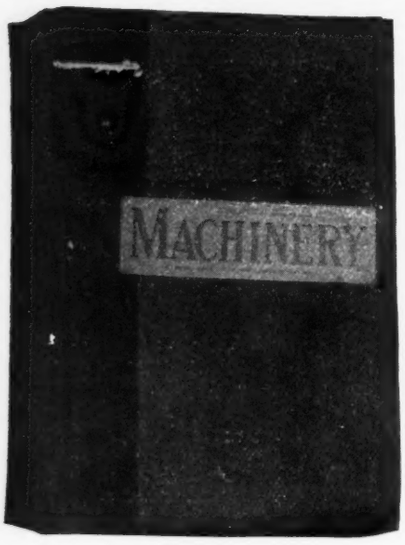


Fig. 1. View of the Closed Binder.

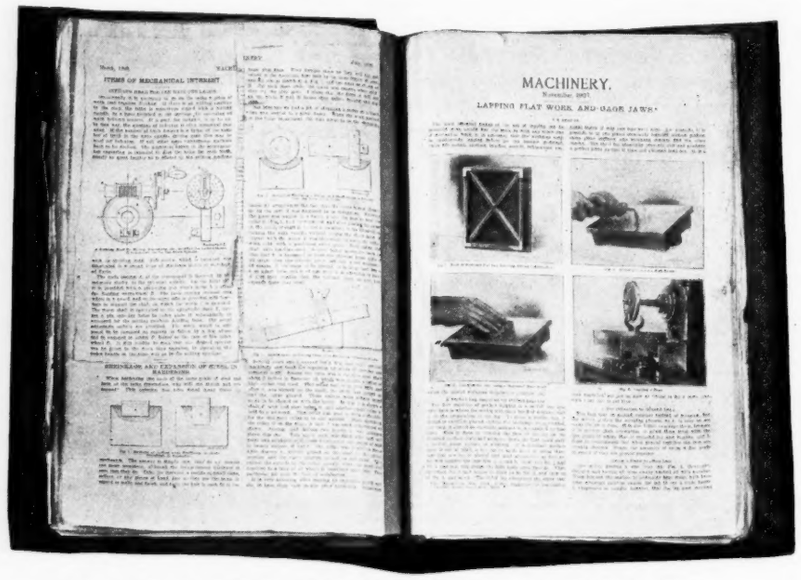


Fig. 2. View of the Opened Binder, showing the Method of Attaching the Leaves.

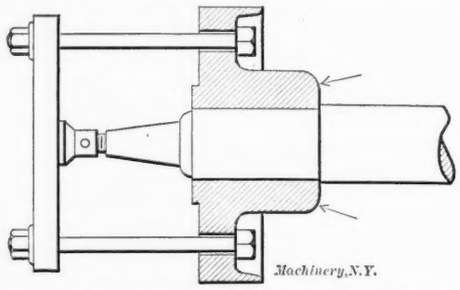
inch of the binding. Pages from MACHINERY containing articles of special interest are fastened into the holder by pasting them to these short leaves, as indicated in Fig. 2. If the back of the page contains nothing of particular interest, short articles or interesting notes can be pasted upon it, as shown to the left, in Fig. 2. If possible, it is better to obtain a cover which exceeds the size of the page by about one-half inch. The writer was fortunate enough to secure a new invoice book with gummed leaves, which is admirably adapted to this purpose.

By the use of such a binder, a very valuable book may be made up in a comparatively short time, which will go well with MACHINERY'S Data Sheets, and Shop Operation Sheets, and in this way a large amount of material, valuable for reference purposes, may be kept in a small compass, thus enabling the mechanic to keep track of various modern appliances and ways of doing work. J. A. CALESS.

Providence, R. I.

REMOVING A FLANGE COUPLING FROM A SHAFT.

No doubt many of the readers of MACHINERY have had experience in removing flange couplings from shafts, and have found that it is not always an easy job. This is especially true if the shaft is of considerable size and has run in a damp pit for several years and consequently has become corroded. Such was the condition of a coupling on an 8-inch shaft in a tube mill in which the writer was employed. This coupling had to be removed, and, of course, it was a Sunday job. The honor (?) fell to another machinist and myself, with the assistance of a couple of husky laborers. The shaft was first jacked up in a convenient working position, and the coupling and shaft well soaked with kerosene.



Removing a Flange Coupling by the Application of Blows in conjunction with Pressure.

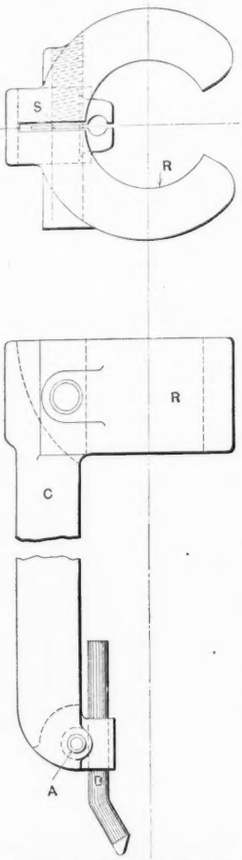
Sledging was then tried, but to no avail, so a fire was kindled under the coupling with the idea of expanding it and, of course, removing it with ease. To facilitate the heating process, a gas pipe was run from one of the nearby heating furnaces. After the coupling was thoroughly heated, sledging was again resorted to, but it seemed as solid on the shaft as ever and refused to move. It was then decided to subject the coupling to a pressure while it was being struck with the sledge. To accomplish this, a couple of 1¼-inch bolts, a heavy cross-piece, and a jack screw were procured and arranged as shown in the engraving. The jack was tightened as tight as one man could pull it, and then, while two men did the sledging at the points shown by the arrows, one man pulled on the lever of the jack-screw. In this way the coupling was moved an appreciable amount with each blow of the sledge. It was removed slowly, of course, but with comparative ease.

This "kink" may be familiar to some, and probably there are those who know of a better way of doing the job, but to any who have work of this nature to do and do not happen to have a better way, I can conscientiously recommend the above method, as it proved in actual practice to be effective. T. W. H.

[The method of removing the flange coupling, as described in the foregoing, by the application of blows from a sledge in conjunction with pressure from a jack, can often be advantageously applied in connection with work of this kind. Tight locomotive frame bolts can often be started by applying pressure from beneath with a jack, and then striking the frame, near the bolt head, a sharp blow with a sledge. The work of forcing crank-pins, locomotive driving-box brasses, etc., in place, when power presses are not available, can also be greatly facilitated by the application of this method.—EDITOR.]

DRILL STOP.

The appliance shown in the accompanying engraving is intended to act as a stop for the drill press when drilling holes required to be of a certain depth, using the hand feed. The feature of the device is that the stop pin *D* acts directly against the top surface of the work to be drilled, so that the depth of the hole to be drilled will always be gaged in relation to this surface. The appliance was introduced for the purpose of drilling a number of 5/8-inch holes exactly 3/4 inch deep. The casting *C* is provided with an open ring *R* at the top, which is finished on the inside to fit the sleeve of the drill press. A 1/8-inch slot is sawed into the casting *C* at *S*, and a collar-head screw tightens the finished ring on the drill press sleeve. The pin *D*, at the lower end of the casting *C*, is made of 3/8-inch drill rod; the point of this pin is slightly rounded, so that it will always find its way through the chips down to the solid surface of the work. The point is adjustable up and down and is held in place by a screw at *A*. When the pin *D* is once adjusted so as to allow the drill to enter into the stock the required depth, no more attention need be given it. The point of the pin is bent so as to bring it near the drilled hole. The fixture is very cheap and simple to make, but it answers the purpose for which it is intended very nicely.



A Stop for Drilling Holes of Uniform Depth.

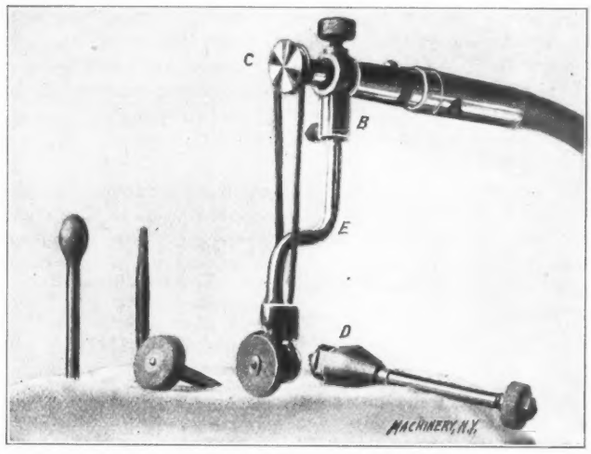
R. B. LOVEJOY.

[It will be noted that this stop for the drill press differs in some important respects from such stops as may be provided right on the spindle in the form of collars, nuts, etc. When once set in relation to the drill employed, it will always prevent the drill from entering into a piece of work more than a fixed amount, inasmuch as the pin *D* stops against the top surface of the work itself. In the case of a collar or nut applied directly to the spindle, if the table be lowered or raised, the depth to which the drill will enter into the work will vary accordingly; hence the advantage of a drill stop such as illustrated.—EDITOR.]

ATTACHMENTS FOR FLEXIBLE SHAFT GRINDER.

The accompanying engraving shows the attachments that we use in connection with a flexible grinder, all of which will be found most convenient in any shop where steel of irregular shapes has to be worked or ground. *A* is the stationary part of the flexible shaft to which is fitted clamp *B* which holds the emery wheel extension equipped with a small pulley, as shown. On this extension and near to the emery wheel is soldered a piece of sheet metal which serves to increase the belt contact, thus preventing slipping. Slackness in the belt is taken up by adjusting the rod *E* in clamp *B*. Pulley *C* is the driver and is screwed direct to the revolving member of the flexible shaft. The belt is in one piece cut from the rawhide with a sharp knife, thus avoiding any joint.

This attachment is used principally on drop-forging dies, and with it concave surfaces can be reached and ground, that would otherwise be inaccessible. The attachment and pulley *C* can be removed and replaced by small chuck *D*, which



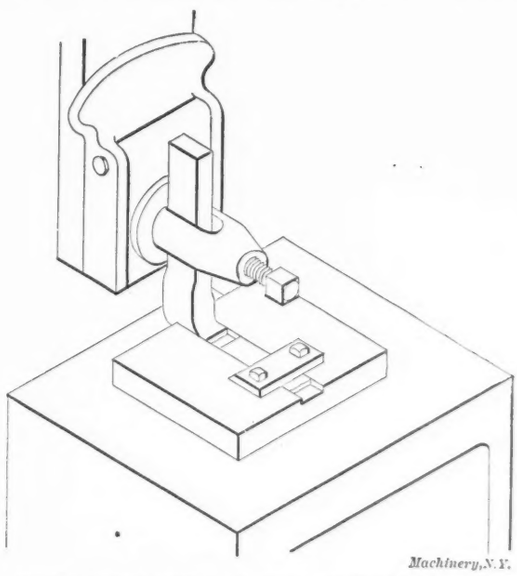
Attachments and Tools for Flexible Shaft Grinder.

holds the tools shown in the engraving. The two emery wheels are most convenient for grinding hardened punches and dies, or the rougher class of drill bushings that just need the high sides eased off. The burrs to the left, which are cut similar to a file, also fit chuck *D* and are used for drop forging dies. This flexible shaft is held in the hand, resembling an overgrown dentist's engine. It should run at about 3,000 R.P.M., and will save lots of hard scraping, lapping or polishing, according to the nature of the job.

West Toronto, Canada. W. J. THOMPSON.

OLD SHAPER CONVERTED INTO A SHAVER.

An old, worn-out shaper was once put to work reducing the stock on printers' slugs, but not in the usual manner. These slugs were both of steel and of brass, some 0.083 inch and some 0.166 inch thick. The stock, as it came from the mills, was from 0.001 to 0.003 inch too large, and as these slugs



Shaving Printers' Slugs to the Proper Thickness in the Shaper.

were put through in lots of several thousand at a time it was no small task to bring them down to exact size. After experimenting in different ways that all proved too slow, an old shaper was converted into a "shaver," as shown in the line engraving. The block on the table was grooved 0.83 inch deep, and across one end of the groove was bolted a hardened strip of flat steel for a cutter. This strip was slightly raised

at the outer end to give the slug clearance as it was passing through. The slugs were shaved as fast as they could be fed in by hand, succeeding pieces pushing out the previous ones so that the tool did not have to run far under the cutter and could therefore be made with a short and stiff end. Directly beneath the cutter was inserted a hardened plug furnished with means of adjustment after being ground. An occasional drop of oil on the cutting edge was necessary to prevent "biting."

When the thicker slugs were shaved the cutter was raised by putting under it steel blocks 0.083 inch thick, leaving a space 0.166 inch high. It will be noticed that one edge of the cutter is ground square and the other with a bevel face. For work on the brass slugs the cutter was reversed and the edge with no rake brought into service. DONALD A. HAMPSON.

Middletown, N. Y.

[A device in which identically the same principle was made use of was illustrated in the March, 1900, issue of MACHINERY, and was contributed by Mr. W. A. Bright. Here drop-forged keys, which were too wide, were shaved off from 0.010 to 0.012 inch on the side.—EDITOR.]

MACHINE FOR GRADUATING INDEX WASHERS.

A hand-operated machine for graduating the index washers used on the screws of lathe saddles and milling machines, is shown in Fig. 1. This machine automatically indexes the work and varies the length, in this case, of every fifth and tenth graduation line as illustrated in Fig. 2. The cutting tool *A*, which is adjusted by the knurled screw *B* for dials of different diameters, is mounted on a slide *C* which is reciprocated back and forth by the handle *D*. The work is mounted on an arbor having a taper shank which is inserted in the spindle of the machine. Attached to the end of the spindle is a worm-wheel meshing with a worm on the shaft of which

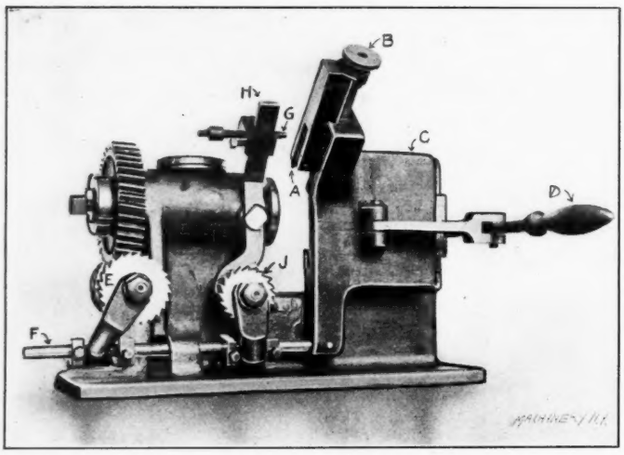


Fig. 1. Machine for Graduating Cylindrical Work.

ratchet *E* is mounted. As will be seen in the engraving, the pawl which meshes with this ratchet is operated by tappets on the rod *F*, which is attached to the slide *C*. In this way the work is indexed for each stroke of the tool, the movement taking place on the back stroke. The lengths of the graduations are regulated by the adjustable screw *G*, which strikes against the top of the pivoted tool *A*, thus lifting it out of

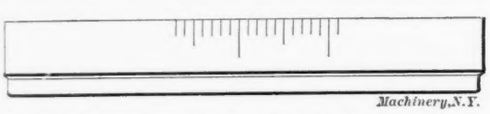


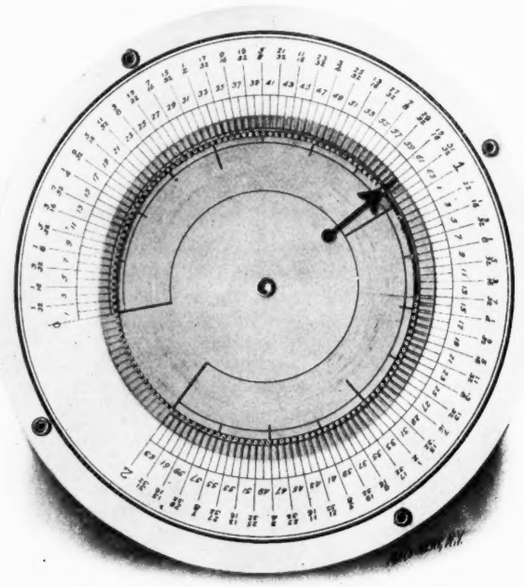
Fig. 2. The Lengths of the Graduating Marks are Varied, as shown, Automatically.

its cut. As the tool leaves the cut the marks are tapered to a point, and this finish gives them a very neat appearance. The lever *H* to which the stop-screw *G* is attached, is pivoted in the center, as shown. The end of this lever is pressed against a cam, by means of a flat spring, which is located just back of the ratchet wheel *J*. As the cam is rotated by means of the ratchet and pawl which connects with the rod *F*, it presents to the end of the lever *H* which presses against it, slight indentations at each half revolution, into which the end of the lever is pressed, thus varying the position of the screw *G* and changing the length of the graduation mark. This cam is rotated in such a ratio to the work, that the end of the lever sinks into a depression at every fifth and tenth stroke, and, as one depression is slightly deeper than the other, each tenth stroke of the tool is made longer, as illustrated in Fig. 2. The particular machine shown is geared to graduate the work into 250 divisions, but, obviously, different numbers of graduations could be provided for.

Keighley, England. C. H. CATON.

CIRCULAR "SLIDE-RULE" FOR ADDITION AND SUBTRACTION OF FRACTIONS.

The accompanying halftone shows a very useful device for use in any engineering office and for the aid of any shop man having considerable work to do in the way of checking drawings. The purpose of the device is to assist in



Device for Adding and Subtracting Fractions.

quickly and correctly adding common fractions, and a little practice with the device will fully demonstrate its usefulness. It is made from two celluloid disks, one larger in diameter than the other, and pivoted together in such a manner that the upper or smaller disk can be moved around the center relative to the larger or bottom disk. The manner in which the larger disk is graduated is plainly shown in the illustration. Each of the small divisions represents one-sixty-fourth of an inch.

To illustrate its use, suppose we desire to work the following example: 5/64 + 5/16 + 1/2 + 1/16. The process would be as follows: Place the chart at your left hand with the ends of the fingers resting lightly upon the lower disk, and with the pencil in the right hand, place the point in the small hole at the arrow and move the disk around by this means until the arrow point is opposite and in line with the graduation 5/64, then hold the disk with the finger of the left hand and set the pencil in the small hole opposite zero; now again move the disk without removing the pencil from the hole until the line coinciding with this hole on the upper disk is opposite 5/16; again, hold the upper disk with the left hand and set the pencil back to zero without moving the disk; again, place it in the new hole opposite zero and move the disk around until the line coincides with 1/2; repeat the operation setting the pencil point back to zero and rotating the disk to 1/16; finally read opposite the arrow point 61/64, or the sum of the several fractions.

Any number of fractions can be added, if after the arrow has passed the point marked 1, the pencil is set in the hole opposite this point and the disk moved back to zero, which in reality deducts one whole unit from the sum of the fractions, and this point carried to the column of units, which are

added. The purpose of this device is for adding fractions only, the whole numbers being added mentally or otherwise. A fraction may be as readily subtracted as added if the operation is reversed. A column of fractions may be added and one subtracted from it without taking any note of any of the readings except the final answer. F. N. WHITESELL.

Three Rivers, Mich.

TOOLS FOR BENDING PIPES.

The articles describing pipe bending devices in the September and December issues, have been very interesting to me because they represent the very latest practice in fixtures of this kind. Especially is this true of Mr. Little's article in the December number, in which he takes pains to explain a few of the important details, the neglect of which is likely to cause trouble for a novice in this line. All of Mr. Little's suggestions are of a very practical nature, and my experience has been such as to give endorsement to them all with the slight exception of the one in which reference was made to the shape of the "business end" of the horn or mandrel. Where the wall of the tube is comparatively heavy and the radius of the bend large, it is possible to bend the pipe with a mandrel that is simply rounded on the end by a cut-and-

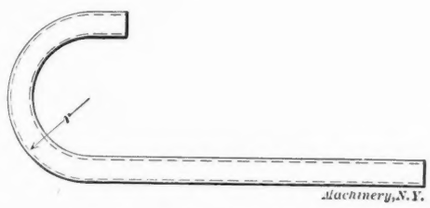


Fig. 1. Shape of the Bend produced by the Tools shown in Figs. 2 and 4.

try method, but the conditions are quite different when the material to be bent is thin brass tubing, say about 26 B. & S. gage (0.015 inch thick). I will state my problem, describe the fixture for bending the tube, and also the method of obtaining the correct shape for the end of the mandrel.

The tube to be bent is shown in its finished shape in Fig. 1. It is used in the manufacture of a cheap inverted incandescent burner, and the output was required to be at least 2,000 per day. Subsequent polishing made it imperative that the bend should be clean, uniform, and free from any sign of buckling. The fixture shown in Fig. 2 is almost identical in construction with that shown in the December issue, and

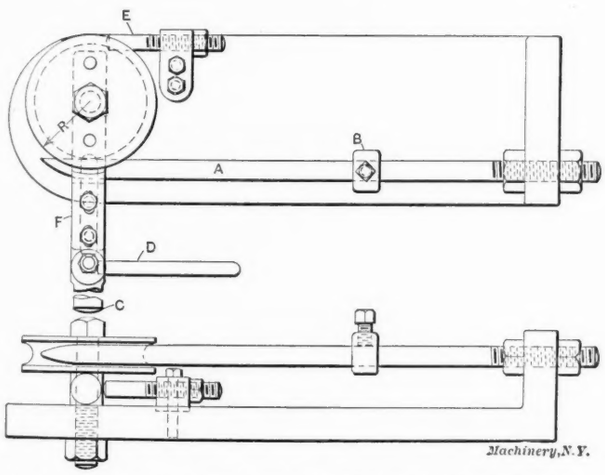


Fig. 2. Hand-operated Tool which bends Thin Tubing without Buckling.

it is therefore unnecessary to describe it in detail. I was able to omit the backing block, and a slight variation in the size of the tubing made it inadvisable to continue the radius R of the swivel block beyond the center of the pipe. Inasmuch as the bend is a complete return, the pipe can be slipped off the mandrel without removing the cam-lever *D* and block *F*. In operating the fixture the tubing, having been cut to length, is slightly moistened with oil on one end and this end is slipped over the mandrel *A* to the stop collar *B*. Then, by grasping the long handle *C* and the cam-lever *D* at the same time, the tube is clamped and the bend quickly started. The bend is finished by bringing the handle *C* up to the adjustable stop *E*. While the long handle *C* remains in this position, the cam-lever *D* is opened and the bent tube is pushed off with the aid of any straight piece applied to the end which remains on the mandrel. The long handle is then brought around in position to make another bend. The method of

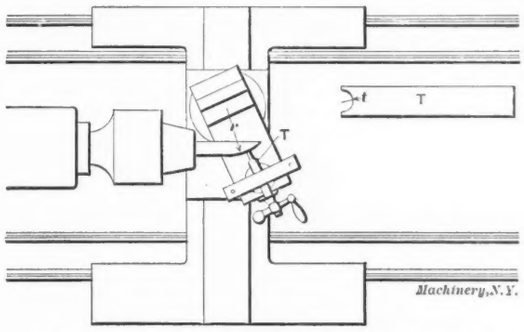


Fig. 3. Method of forming the End of Mandrel A in Fig. 2.

shaping the end of the mandrel is illustrated in Fig. 3. The body of the mandrel is first finished so as to be a sliding fit in the inside of the tube. It is then centered in the chuck and formed by means of a radius tool *T*, having a radius *t* equal to the radius of the mandrel, and a compound rest set to the proper radius *r* (see Figs. 1 and 3.) As the cutting tool is swiveled about the end of the mandrel, which is held stationary, the latter is given the correct shape.

In connection with pipe bending devices, I wish to add a few words in corroboration of your very able editorial on Toolmaking and Manufacturing," published in the December number. There exists today among tool-makers and those having charge of laying out processes of manufacture, a very regrettable lack of knowledge and appreciation of the financial side of every proposition which comes up for consideration. To illustrate my meaning, I wish to call attention to the punch and die, illustrated in Fig. 4, for accomplishing the same results as the hand-operated fixture shown in Fig. 2. When the question of how this work was to be done came up for discussion, the foreman

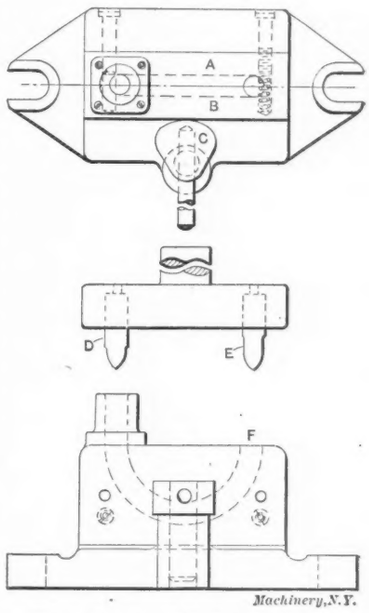


Fig. 4. Punch and Die for Forming the Bend shown in Fig 1.

of the tool department (a first-class mechanic but a sad failure as a business man) was very positive about the meritorious features of the die, and the general manager and I, not having had sufficient experience in this particular line, could not, as a matter of course, offer any serious or well-based arguments against its construction. The die was made as shown, and consists essentially of two steel blocks held together by a cam *C*. A semi-circular groove of the radius of the bend was milled in the face of each block. The punch *D*, descending, pushes the straight piece of tube through the opening between the two blocks. When the operation has been almost completed, one end of the tube, slightly out of round, appears through the opening *F* in the die, and the punch *E* performs the function of giving the hole in this end its original round shape. The cam

is then released, two springs force the blocks apart and the completed article is withdrawn.

Mechanically, the die was a brilliant success and the operation itself was very interesting—so much so, in fact, that it was one of the things which was always called to the attention of visiting stockholders; but commercially it was a difficult matter to make it show a profit. You see it required that a specially-made, slow-speed, long-stroke press should be kept tied up, thus at the outset putting a big handicap on our capacity for some long-drawn brass shells, the weekly output of which was one of the main sources of the factory's income. Naturally, it was impossible to draw shells by hand, and after our good die had withstood a few days' competition with the bending machine, it was only to be expected that it would be put on the shelf, where it has been ever since. Even when the matter is figured down to a plain business basis, the balance is all in favor of the hand-operated fixture. The interest of the money invested in the press and die, the large amount of floor space occupied, the cost of power, maintenance and depreciation, were all heavy charges against the die as compared with the corresponding charges against the fixture; and above all, the accident liability, which is such a troublesome feature in all factories, was practically eliminated on this particular operation. Therefore it must not be taken for granted that everything that is new, novel, and different, will pay a good return on the money invested. HENRY J. BACHMANN.

New York City.

TURNING SOFT RUBBER.

An inquiry appeared in the December issue of MACHINERY in regard to the best method of turning soft rubber. In my opinion, there is nothing which beats grinding. If a knife must be used, it should be kept flooded with water, for as two freshly cut rubber surfaces (rubber being a homogeneous mass, i. e., when properly vulcanized) will adhere considerably if allowed to come together, a great deal of heat is also generated in parting the particles. After seven years experience in a rubber works, where a part of my duties were to weigh the various compounds, I would venture to state that the correspondent who advocates using no lubricant, has never had the pleasure of dissecting a hand of the pure up-river fine Para. He may, however, be correct in his theory about using no lubricant, when we take into consideration the article that perhaps he has been led to believe is soft rubber. The question naturally arises as to what soft rubber is. About the only pure soft rubber that I know of is found in the common rubber band. I do not say that pure, soft rubber cannot be bought, but years ago rubber manufacturers found that it was not the best to use, except for a few special purposes, such for example as linings for sulphuric acid tanks, rubber gloves for laboratory use, etc. If the rubber was white, and it is impossible to make pure white rubber, the correspondent referred to was probably cutting a compound having less than 10 per cent of a less than 90 per cent pure crude rubber, the balance consisting of the various white minerals, such as zinc, barytes, whiting, Paris white, etc., whose sulphites are white.

As one writer has suggested, it would be well to send a sample of the rubber to some reputable manufacturer of abrasive wheels, and abide by his judgment. It is not necessary, however, to buy a new wheel to grind one roll unless it is very large, as any wheel will do the work. Grind dry, but be careful that you do not have a fire—never mind a little smoke and the unpleasant odor. In the inquiry referred to, no specific information was given as to the form of the work, which is, of course, important. If, for example, rubber jar rings are to be parted, a knife is probably by far the most economical, since there is no waste; but for small rolls such as wringer rolls, for instance, for one or two, or even thousands for that matter, where a slight error in size is of no material account, sandpaper applied by hand to the roll, which should revolve at a high speed, is as economical as any. Of course, we are always governed, more or less, by our surroundings. If the piece is not too heavy to stand a high surface velocity, and where only a few slight ridges are to be taken out, with nothing but a lathe without a grinding attachment to do the work with, I would probably rough out the worst places with a file and then use a coarse garnet paper to make the roll approximately true, finishing with a fine grade of sandpaper. If a fine finish is required, it may be obtained on black rubber by the use of cocoanut butter, palm oil, linseed oil, cottonseed oil, or other vegetable oils. The oil is rubbed over the work by hand, until it is well spread, and the result is a nice-looking job, but the use of the oil is somewhat detrimental, as it has the effect of softening and destroying the rubber, more or less. For finishing white rubber, speed up the lathe and rub the work thoroughly with a little soapstone, Paris white or whiting; these latter are perfectly harmless. A. NEWTON HAMMOND.

Erie, Pa.

THE CASTING PUZZLE.

The casting shown on page 369 January number, engineering edition, was probably made by black-leading the bore of the ratchet and casting the bushing therein. Casting the ratchet about the bushing would probably split the former. I made "false-back" hose-couplings on this principle about 1874; they were subsequently patented by Allen. I illustrated them at the time in the *Journal of the Franklin Institute*. ROBERT GRIMSHAW.

Dresden, Germany.

I would like to submit an answer to the casting puzzle mentioned in the January issue of MACHINERY.

A bushing should be first cast from a separate pattern and a pattern made to represent the pawl with the bushing in place; then mold this pattern and let the flanges of the bushing serve as core prints to hold it in position. Next place the bushing in the mold in the same manner as a core or chill and pour the metal around it to make the pawl. This metal will shrink away from the bushing, allowing a little clearance and at the same time chilling the surface about the hole.

Pittsburg, Pa. WM. PFOUTS.

Referring to the casting puzzle in the January issue of MACHINERY, I should, if called upon to make a casting like the one there illustrated, make the pawl first and then machine the hole to size, taking care to make it perfectly smooth. I would then have the bushing cast in it. The pawl will act as a chill, and the iron bushing will shrink in cooling so that it will draw away from the pawl on the inside. To prevent the collars from shrinking fast to the pawl, I would insert some combustible material between the collar or flange and the pawl. The hot iron will burn this material, and after the casting is cool it can be worked out by revolving the bushing.

Windom, Kans. O. A. ANDERSON.

In the January number of MACHINERY, there is illustrated a casting puzzle in the shape of a cast iron pawl which is mounted on a solid bushing, having flanges on either end, on which it is free to rotate. As to the probable method of making this casting, I do not believe, from the foundry-man's point of view, that it would make much difference which piece was cast first—the pawl or the bushing; but, from the pattern-maker's point of view, it would be easier and more practical in making the patterns to have the pawl cast first. Then a coat of some suitable preparation could be applied to the parts of the pawl which come in contact with the bushing. Doubtless a thick coat of glue and very fine sand, supplemented by a coat of "black wash" such as molders use, would accomplish the purpose. In this way sufficient play would be obtained between the pawl and bushing, provided the casting were small, but for larger ones where the shrinkage is considerable, other methods would have to be adopted. A thin false flange of some suitable material could be used under the flanges of the bushing, while the shrinkage of the body would give sufficient clearance. H. V. B.

* * *

Calculated on the basis of present consumption, it is estimated that the available coal supply in Great Britain will last from 500 to 800 years.

SHOP KINKS.

PRACTICAL IDEAS FOR THE SHOP AND DRAFTING-ROOM.

Contributions of kinks, devices and methods of doing work are solicited for this column. Write on one side of the paper only and send sketches when necessary.

A HANDY PENCIL POINTER.

The illustration, herewith presented, shows a very handy instrument for a draftsman to have near his board. It is very easily turned, and ought to be of some hard wood, such as cherry. The slots *A* are gashed into the sides by a thin saw, and small wooden wedges hold emery paper in them. By making two gashes instead of one, two grades of emery paper, coarse and fine, may be used. A small eye is screwed into the handle to hang the instrument up with. The advantage of this kind of sharpener over the flat file, or flat emery paper, is the fact that the points are rubbed up on a rounded surface, which gives a point as shown in Fig. 3. This point is parallel for a short distance, which means that the point is the same for a longer period of use. Fig. 1 shows a point rubbed up on a flat surface, and it is easily seen that every stroke of the pencil makes the point thicker.

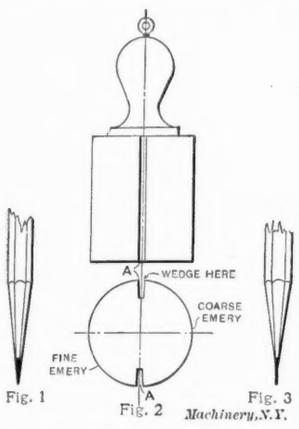


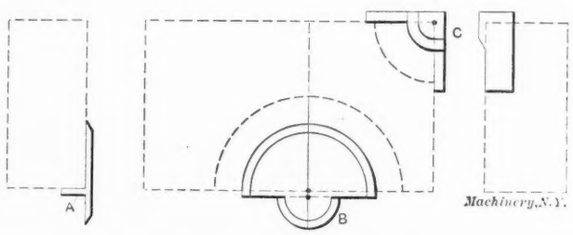
Fig. 1 Fig. 2 Fig. 3 *Machinery, N.Y.*

F. C. DOUGLAS WILKES.

Scranton, Pa.

CENTERS FOR SCRIBING SEMI-CIRCLES FROM THE EDGE OF A BLOCK.

When it is necessary to draw a half circle on a block of metal or wood, the center of which comes on the edge of the block, the tool shown in the illustration will be found very useful, as it makes it possible always to have the center in the tool box. This tool is made of thin steel or brass and has



Machinery, N.Y.

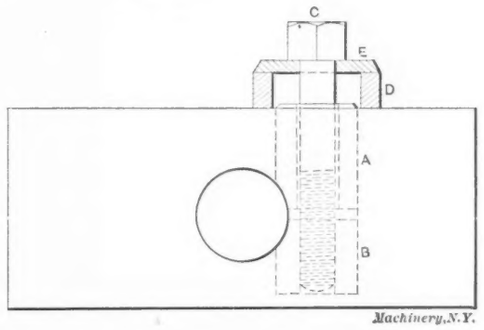
centers which may be aligned with the edge of the block upon which the semi-circle is to be drawn. It will be noticed that there are two centers; one on each side of the perpendicular locating piece *A*. The side *B* is made smaller so that the tool can be reversed and used for drawing circles of smaller radii. The other tool shown at *C*, which is made on the same principle, is used on corners.

F. A. ROSS.

Beloit, Wis.

REMOVING BUSHINGS FROM TURRETS.

In the accompanying sketch, a common form of turret tool binder is shown, which consists of two bushings *A* and *B*, located about one-eighth inch apart, and cut out to the same radius as the hole for the tool. Tightening the screw which passes through the tool bushings, draws them together, as *B* is tapped and *A* is a sliding fit on the screw. In this way the tool is gripped tightly. After considerable use, it will usually be found that the two bushings have become so worn on their working faces that they come together and do not grip the tool. Upon trying to remove them so as to file the ends, difficulty will often be met with, as the ends are usually pressed out so that they are a tight fit in the holes, and the bushings are so located that they cannot be driven out. The illustration shows a very effective way of doing this work. A screw *C* is made longer than the regular one, and in addition, three or four collars *D* and one washer *E*. It is obvious, by referring to the sketch, that tightening down on the screw *C* will draw the bushings up. When *A* comes into contact with the washer *E*, the screw *C* can be removed, a thicker collar *D* put on, and the operation repeated until the bushings are



Machinery, N.Y.

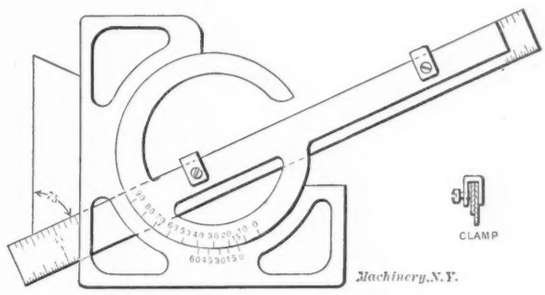
out of the hole. In case there is only one bushing, as *A*, the binding screw working right in the solid metal as in some of the older types of machines, tap in the bushing *A*, and proceed to draw it out as described.

PAUL W. ABBOTT.

Wilkes-Barre, Pa.

EXTENSION FOR DRAFTSMAN'S PROTRACTOR.

While the well-known draftsman's protractor, shown in the engraving, was no doubt designed to be used solely for drawing, it also has another use quite as helpful. If a scale is clamped to the blade as shown, it is adapted nicely for measuring or laying out angular pieces, which the draftsman often has to do. Although the scale can be used in many



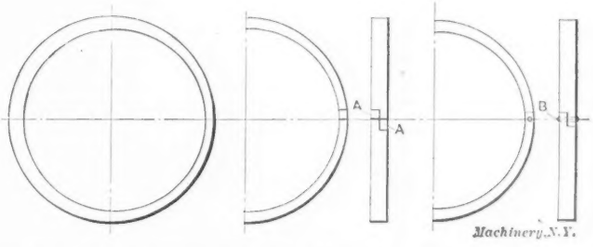
Machinery, N.Y.

cases, a straight-edge, beveled at the end, could be used, perhaps, to better advantage, as it would permit getting into recesses where the scale could not be placed. As the vernier is graduated to read to 5 minutes, very accurate measurements can be made when necessary.

C. E. J.

METHOD OF MAKING PISTON RINGS.

The following is a brief description of a method of making piston rings, which may interest the readers of MACHINERY. First, the ring is roughed out and bored slightly eccentric, as shown in the illustration. The lap joint is then milled, as shown, the portions *A A* being removed on the thin side, after which the ring is clamped together and held with a small



Machinery, N.Y.

pin *B*, made of drill rod. The ring is next bored to the exact size desired, and then put on an expanding arbor and finished outside, care being taken to preserve the eccentricity. With this method, a ring can be made that is almost perfect, and one which is well adapted to gas engines.

W. E. MOREY.

Chicago, Ill.

HOW AND WHY.

A DEPARTMENT INTENDED TO CONTAIN CORRECT ANSWERS TO PRACTICAL QUESTIONS OF GENERAL INTEREST.

Give Details and name and address. The latter are for our own convenience and will not be published.

The following questions are referred to the readers.

L.S.—I wish to cast a 1/16-inch wall of rubber around a piece of sheet metal 1/32 x 3/8 x 3 inches long. What process is used to make rubber flow into narrow cavities?

L. B. D.—Please publish a table giving the proper proportions of steam whistles in all commercial sizes; also the same data for steam sirens.

K. A. T.—What is the practice followed in regard to shape of tools and grade of steel for grooving chilled cast iron rolls used in flour mills? What is the common cutting speed, and how are the rolls prepared for the grooving operation?

J. W. F.—Can you give me information regarding the bending and forming of fiber sheets 3/16 to 1/4 inch thick? We have been experimenting considerably, but cannot obtain satisfactory results. We soften the fiber by steam, but if we make it soft enough to form a square corner it splits up; and if it is not softened so that it splits, it breaks in making the desired bend.

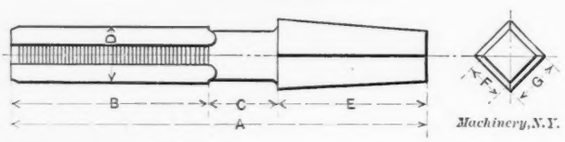
C. L. L.—Can you give me a good formula for a bluing compound, like that used by gun manufacturers for bluing the steel parts of revolvers, etc.? I have a formula which calls for 2 parts crystal chloride of iron, 2 parts solid chloride of antimony, 1 part gallic acid and 4 or 5 parts water. An expert chemist declined to fill it, saying it was not a practical formula, *i. e.*, the ingredients would not properly mix.

DIMENSIONS OF BIT-BRACE TAPS.

S. C.—What are the dimensions commonly used for bit-brace taps? Are the shanks of all bit-brace taps made the same, and what is the commonly used size of the taper square shank?

A.—Below will be found a table giving the dimensions generally employed by tap manufacturers in making bit-brace taps. Two sizes of shanks are generally used, the smaller size being employed for taps up to ½-inch diameter, and the larger size for taps ½-inch in diameter and larger. While

TABLE OF BIT-BRACE TAPS.



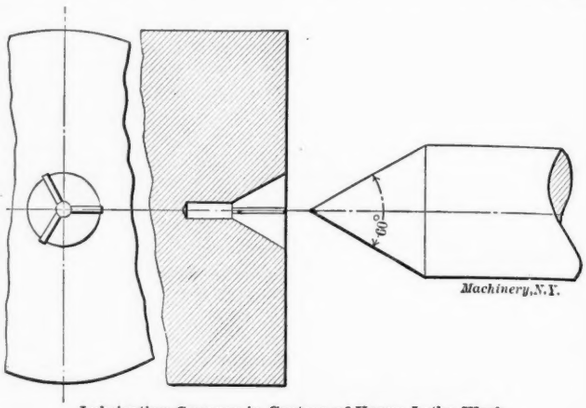
Diameter of Tap.	Total Length.	Length of Thread.	Length of Neck.	Length of Shank.	Size of Square, Small End.	Size of Square, Large End.
D	A	B	C	E	F	G
3/16	3 1/2	1	1	1 1/4	7/32	11/32
1/4	3 5/8	1 1/16	1 1/16	1 1/4	7/32	11/32
5/16	3 1/4	1 1/8	1 1/8	1 1/4	7/32	11/32
3/8	3 5/8	1 3/16	1 3/16	1 1/4	7/32	11/32
7/16	3 1/4	1 1/4	1 1/4	1 1/4	7/32	11/32
1/2	3 5/8	1 3/8	1 1/4	1 1/4	1/4	7/16
9/16	4	1 1/2	1 1/4	1 1/4	1/4	7/16
5/8	4 1/8	1 5/8	1 1/4	1 1/4	1/4	7/16
11/16	4 1/4	1 3/4	1 1/4	1 1/4	1/4	7/16
3/4	4 3/8	1 7/8	1 1/4	1 1/4	1/4	7/16

some tap manufacturers list these taps up to ¾-inch size, they are not commonly used larger than ½-inch diameter, and it is evident that to tap a ¾-inch hole with a bit brace would be rather a laborious job. The taps are usually provided with four flutes. The shanks may be milled to size, in which case no further finish is required. In most cases, however, tap manufacturers forge the shanks to size and then simply grind or file off the fins or burrs. These taps are not made in sets of taper, plug and bottoming taps, the same as hand taps, but the chamfer on the end of the taps is made similar to a plug tap chamfer.

LUBRICATING GROOVES IN CENTERS OF HEAVY LATHE WORK.

W. U.—Having a cast iron cylinder weighing about 600 or 700 pounds to turn in a lathe I filed three grooves in the centers with a small square file, as shown in the accompanying illustration. These grooves were filed for lubricating the centers, and is a practice that I have followed very successfully, never having any trouble with centers cutting or squealing. A shopmate says he would not follow the practice as a cylinder turned with grooves cut in the centers, as shown, will be slightly out of round at points corresponding to the location of the grooves in the centers. Is his contention sound?

A.—Undoubtedly the narrow grooves cut in the centers do have a slight influence on the roundness of the work turned, but if the grooves are cut narrow, the influence would be so



Lubricating Grooves in Centers of Heavy Lathe Work.

slight as to be practically negligible except, perhaps, for calendering rolls or other work requiring a highly accurate surface. No doubt the practice saves much trouble when turning long, heavy shafts, as thorough and constant lubrication is possible. The objection to cutting grooves in the work can be met by grooving the lathe tail-stock center, one groove being placed in a position midway between the horizontal and vertical planes so as to permit the oil to run into the bearing and still avoid the slight reaming action that might follow placing the groove at the top. Cutting spiral grooves in the work centers might overcome all objections.

* * *

The different spirit in Europe and America in regard to peaceful achievements and destructive policies of warfare is hardly ever better exhibited than by the manner in which advances in science and industry are commented upon in the old and the new world. Whenever some epoch-making invention has been made in Europe the European press, both the daily and the engineering, first of all consider what influence this invention may have on military developments; and it seems as if the whole purpose of existence, in the opinion of a large majority of editorial writers abroad, is merely to excel in military achievements. In America, on the other hand, the first consideration is what influence the new invention will have on the peaceful industries of the country. Perhaps it is largely due to this fact that the industrial progress of the United States has made such rapid strides. Of late, the tendency has been, more than before, to introduce the European military idea in the United States also; but it is to be hoped that any such tendency will be ephemeral, and that in this country industrial progress will never be considered merely as an incident in the perfection of military armaments.

* * *

The latest record to be broken by Wilbur Wright and his aeroplane was that for distance. On December 31st, 1908, he made a continuous flight of 76.5 miles, in 2 hours, 9 minutes and 33 seconds, giving a speed of about 35 miles an hour. This flight was made for the Michelin prize of $4,000 cash, and a $2,500 trophy.

* * *

Maple is recommended by the *Practical Engineer* as the best material for wood pulleys. A pulley made of maple, forty-six inches in diameter by sixteen inches face, was successfully run at a speed of 2,400 revolutions per minute, which is equivalent to a peripheral speed of 5½ miles per minute.

THE PASSING OF THE SHARP V-THREAD.*

Nearly forty-five years ago the Franklin Institute of Philadelphia recommended the Sellers screw thread system for general adoption in the United States, as the United States standard thread. Over forty years ago this system was authorized for the naval service by the Secretary of the Navy, and soon afterwards the system was adopted by the Master Mechanics' Association and the Master Car Builders Association. Nevertheless, the engineering profession has been slow to adopt universally the U. S. thread, and in spite of its shortcomings, the sharp V-thread has been, and still is, used to a considerable extent. It is evident that for the purpose of standardization, the use of two systems of threads where one would be sufficient, is undesirable; and in the case of the sharp V-thread its use is all the more objectionable because a "standard" sharp V-thread does not exist. The shortcomings of the sharp V-thread have been referred to several times in MACHINERY; and the fact that various tap manufacturers have each a different "standard" for V-threads was pointed out, in particular, in an editorial in the engineering edition, October, 1906, entitled "The Flat on the Top of Sharp V-Threads," and also in an article on "Screw Thread Systems" in the February, 1908, issue. The subject has also been referred to in other publications, and a thorough treatment is given in "Hand-Book of Small Tools," by Erik Oberg, pages 8 to 14, inclusive.

For a number of years the tap and die manufacturers in the United States have been considering the advisability of discontinuing the regular manufacture of taps and dies with sharp V-thread. An agreement has now been reached to this effect. The causes which have been active in bringing about this decision may be best set forth by quoting from our editorial in the October, 1906, issue of the engineering edition:

"While theoretically the sharp V-thread is not flatted on the top of the thread, it has, on account of practical reasons, become necessary to provide this kind of thread with a slightly flatted portion. In the first place, it is very difficult to produce a perfectly sharp edge on the top of the thread, and, in the case of a tap, the sharp edge would be very likely to be impaired in hardening, leaving the top of the thread less perfect than if provided with a slight, uniform flat. In the second place, the sharp edge would wear away very rapidly both in the case of a tap and a screw, and as the wear could not be expected to be uniform, the ultimate result would be far less desirable than the one obtained by slightly flatting the top of the screw from the beginning.

"For the reasons mentioned it has always been the practice of tap manufacturers to provide the top of the thread on V-thread taps with a slight flat; but as a standard outside diameter always had to be maintained, the diameter in the angle of the thread had to be increased. This has caused difficulties, inasmuch as there has been no established standard as to *how much* of a flat the thread ought to be provided with; the various manufacturers have each had their own practice in this particular. The result has been that the gages from one firm have not corresponded to the taps manufactured by another, and many customers, not familiar with the reasons for this confusion, have questioned the correct sizes of gages as well as taps. The question has been still more confusing on account of the fact that many manufacturers did not have even a certain standard for all taps manufactured by them, but working to their old-established gages, they often produced large taps with smaller flats on the top of the thread, proportionally, than the flats on smaller taps.

"In order to overcome the difficulties arising from the facts mentioned, we understand that the tap manufacturers are endeavoring to establish a standard flat for the top of sharp V-threads. While, as far as we know, nothing has been definitely agreed upon as yet, there seems to be opinions favoring a flat equal to one-fifteenth of the pitch. This is a greater flat than has hitherto been employed by some leading tap makers. Some have used the same flat for the V-thread as is used for the Brigg's standard pipe tap thread, which, although theoretically rounded at top and bottom, is, in this country at least, made with a small flat on the top of the thread. The width of this flat is selected so as to give exactly the same angle diameter as is obtained when rounding the top of the thread in accordance with Brigg's original proposition. This flat is equal to about one-twenty-fifth of the pitch."

Apparently the various tap and die manufacturers failed to agree upon a definite standard for the flat on the top of the V-thread so as to establish what would have been an exact *standard*, and therefore the discontinuing of the manufacture of taps and dies with this thread has been agreed upon.

As an example showing how the gages for V-threads of different manufacturers vary, the following figures giving the pitch diameter of a ¾-inch tap, 10 threads per inch, as made by ten manufacturers, may be cited. The following are the ten pitch or angle diameters: 0.6702, 0.673, 0.671, 0.6734, 0.6715, 0.671, 0.6714, 0.6715, 0.677 and 0.671. The theoretical pitch diameter is 0.6634.

For a 2-inch gage, with 4½ threads per inch, the pitch diameters of eight manufacturers are as follows: 1.8219, 1.818, 1.833, 1.8176, 1.8187, 1.8197, 1.828, and 1.831. The theoretical pitch diameter in this case is 1.807. It will be seen that in this case a difference of approximately 1/64 inch exists between the gages of two of the manufacturers.

In view of this condition it is clear that it would be advantageous for the manufacturers and the users alike to discontinue the use of the sharp V-thread. It is also clear that the discontinuing of the use of the V-thread is a better solution of the difficulty than the standardization of the thread; because the latter would involve a change in the present practice of all the manufacturers, and during the transition period the standardization would create quite as many serious difficulties as the adoption of a practically new standard. In fact, it seems that it is easier to abandon the sharp V-thread entirely than to try to force a somewhat different standard of the same thread on the trade. As the U. S. standard form of thread fills the requirements of a desirable screw thread so much better than the sharp V-thread, it is to be expected that the majority of the present users of the latter will cheerfully accept the change, and aid the tap manufacturers in their commendable effort of establishing *one* standard. A rapid acceptance of the U. S. standard in place of the V-thread is all the more likely to take place, because the manufacturers propose to charge special prices for V-thread taps and dies, as well as for tools with the old machine screw thread, the place of which latter will be taken by the A. S. M. E. standard for machine screws.

A fact that will be useful to know in making the change is that the pitch diameter of the U. S. standard thread is somewhat larger than the pitch diameter of the sharp V-thread, so that a V-threaded hole can be re-tapped by a U. S. standard thread tap.

* * *

TREND OF AUTOMOBILE DESIGN.

An analysis of the cars of the exhibit at the last Madison Square Garden Automobile Show, made by the *New York Times*, is of interest, giving as it does the general trend of design and use of motor cars. There were on display 117 complete gasoline cars, 28 gasoline chassis, 19 motor business wagons, 5 motor business chassis, 3 taxicabs, 6 steam cars, 1 steam chassis, 37 electric carriages, and 5 electric chassis. A great majority of the gas engines had water-cooled cylinders, there being 138 water-cooled, and 7 air-cooled. The four-cycle type of engine was in the majority; there were 140 of the four-cycle type and only 5 of the two-cycle type. In cylinder construction there was considerable variety, there being 25 six-cylinder models, 116 four-cylinder, 3 three-cylinder, and 1 single cylinder. Of these, 96 were in pairs, 41 were cast separately, and 6 *en bloc*. The jump spark ignition was used on 125 cars and 20 cars had the make-and-break system; 48 of the cars used the double-jump spark system, 56 the dual, and 21 the single system. In clutches the cone and multiple-disk were equal, each type being used on 56 cars. On the remaining cars, 22 used the expanding clutch and 10 the contracting type. The selective gear was the most popular in transmission devices, 121 using the selective and only one using the planetary system.

* The following articles relating to screw-thread systems have been previously published in MACHINERY: Whitworth *vs.* Sellers Thread, May, 1899; Screw Pitches in Foreign Countries, February, 1900; Screws, September, 1903; Proposed Standards for Machine Screws, June, 1906; British Standard Fine Screw Thread, October, 1906; The Flat on the Top of Sharp V-Threads, October, 1906, engineering edition; Automobile Fine Screw Threads, November, 1906, engineering edition; Standard Proportions for Machine Screws, December, 1907, engineering edition; Screw Thread Systems, February, 1908. See also MACHINERY'S Reference Series, No. 31, Screw-Thread Tools and Gages, page 3; Screw-Thread Systems.

NEW MACHINERY AND TOOLS.

A MONTHLY RECORD OF APPLIANCES FOR THE MACHINE SHOP.

BICKFORD & WASHBURN TAP THREAD MILLING MACHINE.

In the article on The Manufacture of Taps in the January, 1909, issue of MACHINERY, was shown an engraving (Fig. 6) illustrating the method of threading and relieving tapered taps by milling. This method of cutting taps has been used for many years, special machines having been built by tap manufacturers for the purpose. The firm of Bickford & Washburn, Greenfield, Mass., has now for the first time placed a machine of this type on the market for general use in tap manufacturing. It is the design of Mr. O. S. Bickford, who has had many years experience in tap manufacturing. It has

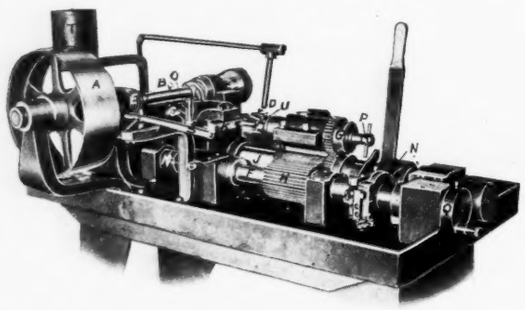


Fig. 1. Mechanism of the Bickford & Washburn Tap Machine.

been his aim to incorporate in this machine such improvements and adjustments as will fit it for a wide range of work in general use.

Briefly, the operation of the machine is as follows: The milling cutter *D* is cut with circular (not helical) grooves of the cross section of the desired tap. This cutter is fluted helically to give a smoother cutting action than would be possible with straight flutes. This cutter revolves continuously. The tap *U* is mounted in front of it, parallel with it if a straight thread is being cut, and at a suitable angle in the case of a taper thread. The tap revolves slowly at a feed suitable for the cut being taken. It is moved forward as it is revolved by a lead-screw geared to the pitch of the thread. The blank is fluted previous to this threading operation, to permit the machine to be arranged for relieving as well. For relieving, mechanism is provided which moves the tap in as the cutting action approaches the heel of the land, and brings it out again to the full diameter when the hob starts in again on the next cutting edge. The arrangement of mechanism provided for giving these movements, will be understood by reference to the accompanying engravings and the following description.

The driving pulley is shown at *A*. This is connected to the driving shaft *B* by a clutch which is automatically disconnected at the completion of the work. This clutch may be operated by hand lever *S*. Coarse pitch spiral gears, one of bronze and the other of steel, connect this driving shaft with the cutter spindle *C*, on which the hob *D* is mounted. This spindle has a taper front bearing with a large collar for end thrust. The rear bearing is of the tapered and split bushing type, adjusted by threaded collars at each end. The cutter or hob, as is shown more plainly in Fig. 2, is carried on a short stiff arbor supported at its outer end. This rigid mounting permits the taking of very heavy cuts without vibration. The whole of this hob driving and carrying mechanism is mounted on a slide which may be adjusted in or out to suit the diameter of the work, though a fine adjustment for accurate sizing is provided in addition to this, as will be explained later.

The rotary feeding movement of the blank is obtained from the driving shaft through worm gearing *E*. The vertical worm-wheel shaft in turn drives (through a second set of worm-gearing) a short shaft which is connected by change gears (not visible in either illustration) with the camshaft *F*. The gears provided at this point give five changes of feed. One of the principal functions of shaft *F* is to revolve the work and feed it forward to agree with the pitch of the thread being cut. To permit this movement, the work *U* is driven from its squared end by work spindle *G*, which is in turn connected by the gears shown with driving gear *H* on camshaft *F*. Spindle *G* is mounted in an adjustable head clamped to bar *J*, which forms the real carriage of the machine. The outer end of the blank is supported by a center in slide *K*, also held in a second head on bar *J*. The axial movement is given this bar and the work which it supports by a short lead-screw at *N*, which, through the split nut at *L*, controls a yoke on shaft *J*. It will thus be seen that as camshaft *F* slowly revolves, the work is revolved in unison and fed forward at the same time by lead-screw *N*, which is made of the same pitch as the work.

Besides having this axial movement, bar *J* and the work holding members may be rocked about the bearings of the bar to bring the work closer to the hob or further from it. This movement is controlled by a series of cams *M*, any one of which may be brought beneath the point of adjusting screw *O*. These cams have four lobes for four fluted hobs, three lobes for three fluted hobs, etc. The point of screw *O*, which is seated in the tail center head, bears on the cam surface, and rocks the work in and out from the cutter to give the desired relief. Screw *O* is also used for the fine

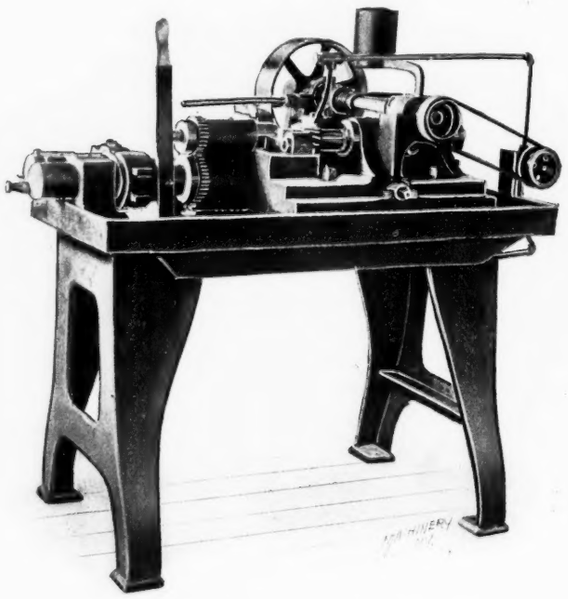


Fig. 2. A Machine for Threading Taps with a Hob.

adjustment for the diameter, being provided with a graduated dial for that purpose. Weight *T* keeps the point of *O* in contact with the cam.

The tap being cut is driven by a dog in the front end of work spindle *G*. Provision for cutting taper taps is made by adjusting tail center *K* crosswise, a fine screw movement being provided for this purpose. The other center is the point of screw *P*, which forms part of the work spindle and is readily tightened. The lead-screw *N* is so attached as to be readily removed for changing from one pitch to another.

In the operation of the machine, the split nuts *L* are first opened allowing bar *J* to be drawn back by lever *R*. The nuts are then closed, the finished tap is removed, the new blank is inserted, and the clutch lever *S* is thrown over, starting the machine again, which completes the new tap and stops itself ready for another blank. The operation in the case of ¾-inch pipe tap requires about three minutes.

The machine is also arranged for threading the hobs *D* which it uses as cutting tools. For this work an ordinary V-milling cutter is used, of the proper shape for the thread. One groove at a time is cut in the hob blank. At each revolution the machine stops and the operator indexes the work ahead by hand to the next groove. The lead screw is free from the influence of the feeding mechanism, and is operated by the knurled index pin in disk *Q*, which seats in a taper hole in the bed.

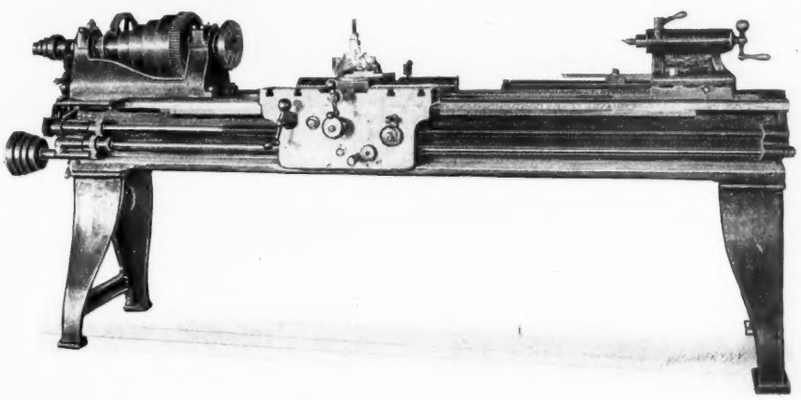
The regular equipment of the machine, so far as the movable parts are concerned, consists of a full set of extra lead screws and nuts, and the dogs necessary for driving the sizes of taps as required by the range of the customers' work; depending on whether right- or left-hand taps are to be cut, and whether Briggs standard or Whitworth shapes and sizes are to be used.

The first machine of this type has been in use for some time and is giving, so the builders state, complete satisfaction to the purchaser. It is threading 2-inch pipe taps at the rate of one hundred per day.

MIAMI VALLEY 15-INCH STANDARD ENGINE LATHE.

The Miami Valley Machine Tool Co., of Dayton, O., has added to its line the 15-inch standard engine lathe shown herewith. Particular attention has been paid in this lathe to giving a strong rigid construction, which will permit heavy cuts without chattering or vibration. The head-stock is massive and has long spindle bearings, bushed with phosphor bronze. The spindle is of high-grade crucible steel, bored with a 1⅜-inch hole. The cone pulley has five steps for a 2¼-inch belt, and the back gear ratio is 9.6 to 1.

Among the conveniences of the carriage is the provision made for reversing the feed in the apron, as well as in the head-stock. The feeds are so arranged that it is impossible to throw in the screw and feed rod motions at the same time. A positive geared feed is provided, obtainable from a connection of the feed rod with the lead-screw. This is in addition to the four belt feeds, which range from 50 to 150 turns per inch. A chasing dial is provided to permit threading without stopping or reversing the lathe.



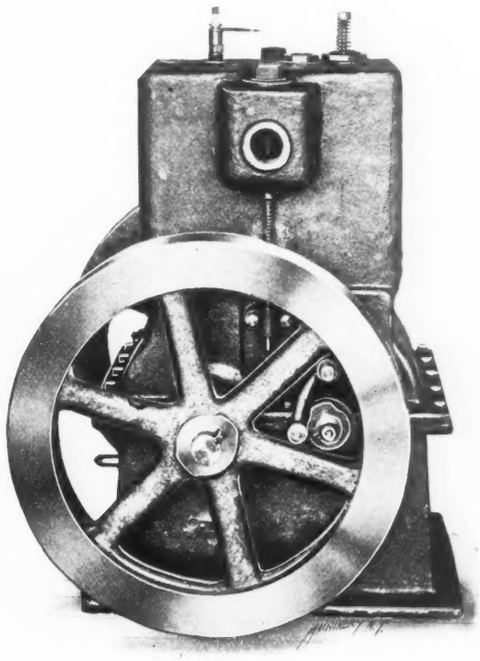
Miami Valley 15-inch Standard Engine Lathe.

The price includes follow and steady rests, change gears, large and small face-plates, double friction counter-shaft and wrenches. The lathe is equipped with a compound rest, but a plain rest will be substituted if ordered. The lathe has an actual swing over the bed of 16½ inches. It will weigh approximately 1,600 pounds with a 6 foot bed.

ACME GAS-ENGINE AIR COMPRESSOR.

The gas-engine-driven air compressor shown herewith is an unusual example of neatness and compactness in design, made possible by combining two separate units in one machine. This apparatus comprises a 5-inch by 5-inch 4 H.P. gas engine and a 5-inch by 5-inch air compressor cylinder, mounted in one frame, and with all parts conveniently arranged for inspection and repair. It is built by the Acme Mfg. Co., Bradford, Pa.

The two cylinders form one solid casting with the valve chambers and the upper half of the crank case. This casting is made of fine gray iron, and has an ample water jacket cast integrally with it, serving for both the gas engine and air compression cylinders. The pistons are duplicates, of the usual gas engine type; they are very light and extra long,



A Gas-engine-driven Air Compressor of Simple Design.

and the rings are placed well to the top. Oil grooves on the lower face of the piston ensure even distribution of the oil thrown against it when exposed at the lower end of the stroke. A flywheel is mounted on each end of the gas engine shaft. They are carefully balanced and of ample weight. The crank-shafts are duplicates except in the matter of length, and are made of a tough, mild open-hearth steel, forged in one piece from the solid billet. The connecting-rods and other parts are also duplicates.

One of the features that allows simplification of the mechanism, is the gearing of the engine crankshaft with that of the compressor in the ratio of two to one. This allows the two members to work at suitable speeds for each, and at the same time permits the use of the compressor crankshaft as a lay shaft for operating the valves of the gas engine. The gears are cut from forged steel blocks and are designed with a factor of safety of ten. They run in a bath of oil, so that the loss of power is negligible. The valves and stems are of special nickel steel drop forgings formed in one piece and carefully turned. They operate vertically, and their stems are guided in long bushings, giving great durability of alignment. The inlet valve area of the compressor cylinder is 35 per cent of the piston area.

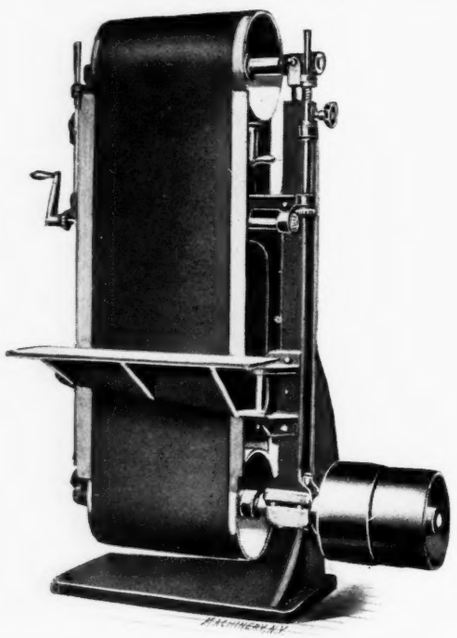
The advantages of this arrangement may be summed up as follows: compactness of design; simplicity and consequent low first cost; thorough lubrication of all working parts from the oil bath in the crank case; vertical mechanically operated valves; rigid cylinder castings and frame; removable long bronze bushings for the shafts, with ring oiling bearings; easy access to the valves; quietness of operation; availability for use under any conditions, with natural, producer or illuminating gases, gasoline or denatured alcohol as a fuel. In

ordering, the purchaser should state the fuel it is proposed to use.

An unloading device, adjustable for different pressures, will be provided if it is desired to maintain a given pressure in the receiver. This allows the engine to be operated continuously. High efficiency is assured by the careful design, the high compression obtained, and the large and freely moving valves. The machine has a capacity of 17 cubic feet of air per minute at a pressure of 250 pounds. It weighs 600 pounds completed.

GILMER IMPROVED VERTICAL BELT SANDER AND POLISHER.

The L. H. Gilmer Co., 504 Arch St., Philadelphia, Pa., is well known as the maker of the Gilmer endless belt, which was first described in the New Tools department of the October, 1905, issue of MACHINERY. The use of these belts for polishing and similar purposes has resulted in the design by this firm of the vertical belt sander and polisher shown herewith. This is so constituted as to run successfully at a belt speed of 4,000 feet per minute, without heating the bearings or causing appreciable vibration. The work is supported by a swinging table, which may be adjusted to any convenient level to suit the work in hand. This supports the weight



Endless Belt Sander and Polisher for Wood and Metal Work.

of the part being polished, so that the operator is free to guide the work with as much care as may be required.

By means of double screws and bevel gears the tension of the belt is adjusted from one side by a single crank. This adjustment keeps the shafts always in line, so that the belt is in no danger of being thrown off. Various special appliances for special work may be used. One of the most useful of these is the provision made for fastening felt or other backing to the machine plate, thus giving a cushion which is very effective for some kinds of work. The working surface is 18 by 24 inches. The bearings are dust-proof and of solid construction. While the machine runs regularly at 4,000 feet a minute, it is tested thoroughly at a speed of 5,500 feet. It may be used as a sand belt for wood-working or (with proper abrasives) for metal finishing.

WEISS REVOLVING WRENCH.

The instrument illustrated in Figs. 1 and 2 should perhaps be called a parallel jaw plier rather than a wrench, if strict definitions are to be followed, but the revolvable feature included in the construction fits it so well for use as a wrench on all parts of work and in all sorts of places, that the title "revolving wrench" is decidedly appropriate. The tool is the invention of Mr. Karl Weiss, 118 Cherry St., Waterbury, Conn.

Fig. 1 is reproduced from a photograph of the tool, and Fig. 2 shows details of its construction. Jaws *A* are guided in suitable slots in the body bushing *B*. In this latter member is mounted a pivot *C*, which carries two gear segments *D*, whose teeth mesh with rack teeth cut on the inner edge of jaws *A*. The longitudinal movement of a thrust bushing *E* presses it against the ends of segments *D*, and rotates them about pivot *C*, thereby closing the jaws together. This longitudinal movement of *E* in the direction of the axis of the tool is effected by gripping the handles *F*, which are thereby rotated about their fulcrums *G*, causing their inner ends to press against *E*. When the grips *F* are released, the coiled springs shown attached to segments *D* open the jaws and the handles again.

Body bushing *B* and the jaws *A* which are mounted in it may be revolved with relation to the handles. The fulcrums

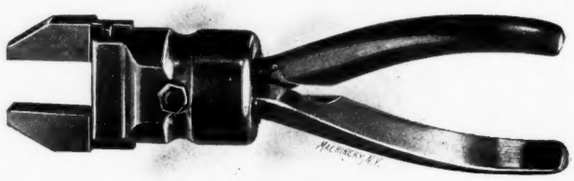


Fig. 1. The Weiss Combined Parallel Pliers and Revolving Wrench.

G, which are cast solid with the handles, bear against the inner end of a sleeve *H*, threaded to *B*. When jaws *A* and bushings *B* and *H* with their contained parts are rotated in relation to the handles, the latter remain stationary along with bushing *J* which supports *E*. When the handles are tightly gripped and the jaws close on the work, the parts are locked against revolving owing to the heavy thrust of pivots *G* against *H*. This makes of the tool an automatic wrench for turning in either direction. In screwing in a nut, for instance, it is tightly gripped between the jaws. This gripping locks the tool, so that the twisting of the wrists turns the nut. A slight release of the pressure loosens the contact be-

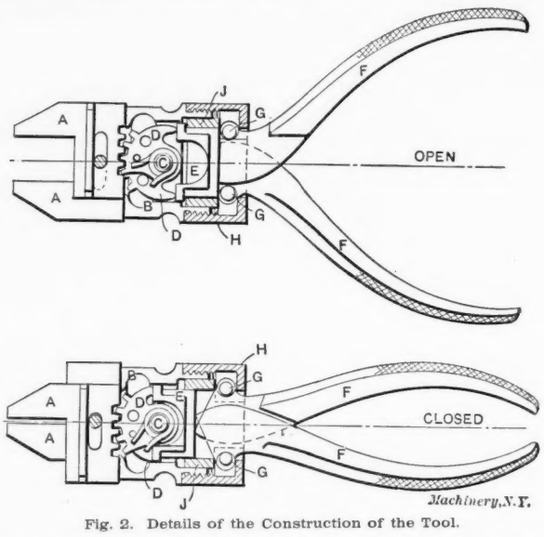


Fig. 2. Details of the Construction of the Tool.

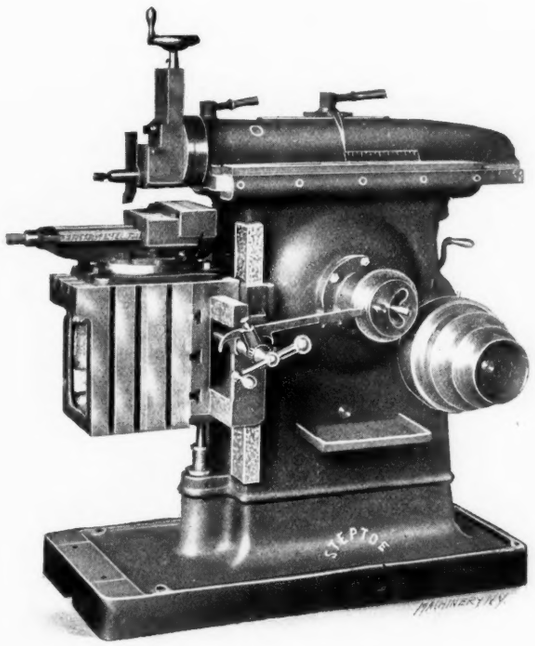
tween *G* and *H*, and allows the wrists to be twisted back again for a fresh grip. The tightening again locks the tool, so that another turn may be given the nut—all of which is done without removing the jaws from their contact with the work.

An ordinary ratchet wrench will not reach in every hole or corner where there is a nut or screw to be tightened. This tool will reach and stay on, giving the operator a chance to rotate the part by the very smallest amount required in a corner, or by the full swing of the hand where that is possible. It does not require a new grip for each one-quarter turn, as with the common parallel pliers. It follows the quickest motion of the workman's hand without loosening the grip on the work or requiring a change of hands.

STEPTOE 16-INCH CRANK SHAPER.

The illustration shows a newly designed back-geared crank shaper made by the John Steptoe Shaper Co., of Cincinnati, O. This design incorporates a number of improvements, among them being a stiffened form of base, a clamping arrangement for the tool-head, and convenient and durable feed mechanism.

The base of the machine on the operating side is strengthened by a basin-shaped brace of thick section. The whole of the base casting is made very heavy to avoid vibration, and consequent unsteadiness of cutting action. The shaft bearings are provided with press-fitted, cast iron, ring oiling bushes. The rings are made of wide strips of brass, giving a much more liberal supply of oil than when wire rings are



An Improved Design of the Steptoe Crank Shaper.

used. The back gears are operated by a lever at the back of the column within easy reach of the operator. The driving gears are of a high grade of phosphor bronze.

The ram is strongly ribbed and heavily braced. The head can be instantly loosened and swiveled to any angle by pushing the lever seen at the back of the head. Pulling the lever forward again clamps the parts together. No wrenches need to be used for this adjustment, thus saving time and annoyance. The change in the length of stroke is controlled by a lever projecting through the feed plate, which can be operated when the machine is in motion. The adjustment in the bull gear is self-locked, being held firmly in position as soon as the adjustment lever is taken off the shaft.

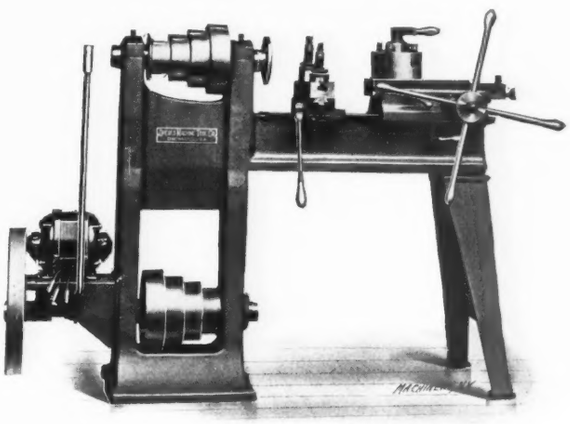
The feed motion is obtained from a variable throw eccentric on the bull wheel shaft. The eccentric is pivoted so that it can be swiveled in either direction, and locked at the desired adjustment by a tapered pin entering reamed holes in the plate. The holes are drilled and numbered to agree with the number of teeth in the feed ratchet, for convenience in changing the feed. The eccentric strap is split and fitted with a fiber washer, so that adjustment for wear may be easily effected by filing this washer as much as may be required. The elevating screw for the table is entirely enclosed, and is of telescopic construction. This prevents oil and chips from getting in under the base, and obviates the necessity for a hole in the floor as well. The base of the vise is graduated for its angular setting on a beveled surface, so that the setting can be easily seen by the operator. Another vital improvement in its construction is offered by the bolts provided for drawing the sliding jaw down onto the base, after it has been set up against the work. As is well known, when fastening work in a vise the outer jaw has a tendency to tilt under the pressure. These clamping screws avoid the possibility of this tipping, and thus assist in securing accurate work.

The builders also manufacture a single geared crank shaper of similar design, with the gear ratio of 6¾ to 1. The back-geared crank shaper herewith illustrated has a single geared ratio of 6¾ to 1, and a back-geared ratio of about 20 to 1.

DRESES MOTOR-DRIVEN TURRET LATHE WITH SELF-CONTAINED COUNTERSHAFT.

A striking arrangement of self-contained motor drive for a brass turret lathe is shown herewith. It was designed and built by the Dreses Machine Tool Co., Cincinnati, Ohio. The motor is of the constant speed type, all the changes being made by shifting the belt, as with the usual countershaft arrangement; in fact, the substance of the design consists in placing the countershaft in the cabinet leg beneath the head-stock, instead of mounting it on the ceiling above the machine. The constant speed type of motor was used in preference to the variable speed form, because the high rate of rotation of the spindle in brass work makes a geared speed changing device practically out of the question. Variable speed motors are also open to the objection that they are most conveniently mounted on the head-stock, where their large size gives an unsightly appearance to the machine, and sets up disturbing vibrations as well. The motor shown in this particular installation has 1½ H.P. capacity, and is of the alternating current, high speed type.

The motor is mounted on a bracket at the left side of the cabinet leg. A rawhide pinion on the armature shaft meshes with the large gear on the cone pulley shaft journaled in the leg. To start and stop the spindle more quickly than is possible by the motor controlling switch, a friction clutch is furnished, operated by the long lever shown at the left, which thus serves to connect and disconnect the lower cone pulley



Motor-driven Brass Finishing Lathe with Countershaft mounted in Cabinet Leg.

and the driving shaft. It will be noticed that this pulley is placed as near the floor as possible to give a long belt and avoid vibration. The bed and cabinet leg are constructed to avoid interference with the shifting belt in any position.

LANGELIER SWAGING MACHINE FOR FINISHING VALVE STEMS.

The Langelier Mfg. Co., of Providence, R. I., has equipped its regular swaging machine with tools and attachments which adapt it to the finishing and sizing of gas-engine valve stems. The advantages of doing this by swaging, rather than by grinding as usual, are two: first, the operation is much more rapid and less expensive; and second, the quality of the metal is materially improved by the compression to which it is subjected in the swaging process.

Fig. 1 shows the machine equipped for this work. Fig. 2 shows the valve in three conditions: the rough forging; after turning the head, and after swaging. The forging (see *A*) is first clamped by the shank in a lathe, the head is turned

and finished all over, and the tapered swell of the shank into the head is machined. The forging is shown in this condition at *B* in Fig. 2. The holder for the swaging operation is shown in Fig. 3. The work is grasped by the finished head in a spring chuck *D*, of ordinary construction, tightened by the coarse-studded screw *E* and nut *F*. To make the operation of this nut and screw by handle *G* as nearly frictionless as possible, a ball thrust bearing is used, as shown. The holder is mounted on a slide *H*, which is actuated by hand lever *J* to force the work back and forth between the dies. The whole attachment is supported by bracket *K*, clamped to the face of the machine.

The finished work is shown at *C* in Fig. 2. It will be noted that a reduction of 1/32-inch has been made in the stem with

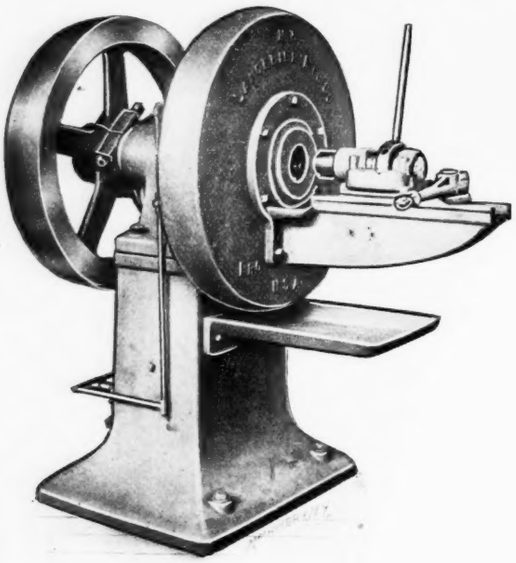


Fig. 1. The Langelier Reducing Machine, fitted with Attachments for Finishing Automobile Engine Valve Stems.

a corresponding increase of length, which of course is allowed for in making the blank. As the valve stem is held by the chuck on its outside diameter and the angular face *x* of the head, this insures the finishing of the stem true with the valve seat. After the swaging operation, the valve is chucked by the swaged surfaces of the stem, and surface *x* trued up by grinding, thus insuring the truth of the important surfaces. Where great accuracy is required, the makers

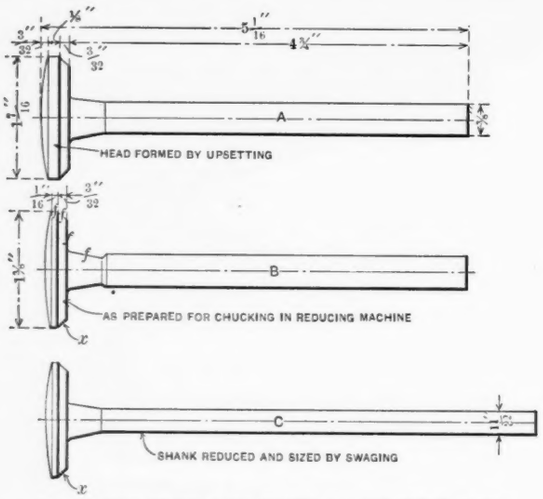


Fig. 2. Three Stages in the Making of a Gas Engine Valve.

advise doing the swaging in two operations. The first operation roughs the stem down to within five or six thousandths of the required dimension; the second operation sizes it and gives it the desired finish. The roughing can be done very rapidly as the finish is not of great importance. The second operation must be done more slowly. In the examples shown, the time required for swaging was six per minute for the

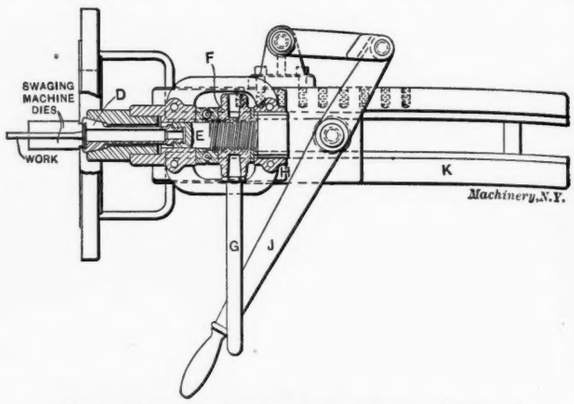
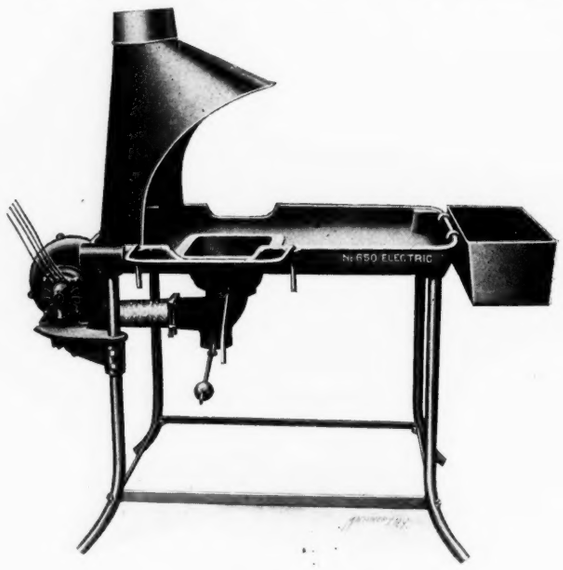


Fig. 3. Plan of the Attachment for Holding the Work and Presenting it to the Machine.

first operation, and three per minute for the second. This included the time for putting the work into the machine and taking it out again.

BUFFALO FORGE WITH MOTOR-DRIVEN BLOWER.

The forge shown herewith is built by the Buffalo Forge Co., of Buffalo, N. Y. It is a new design embracing, among other improvements, an all steel fan directly connected to an electric motor, running 1,700 revolutions per minute. The motor and fan case are securely mounted on a bracket fastened to one of the rear legs. Being mounted on the same base, they are kept permanently in alignment. The only wiring necessary is a plug connection to a lamp socket or, if the forge is permanently located, suitable wiring connections may be made in the usual manner. While the regular



Forge with Direct-connected Motor-driven Blower.

motor furnished is intended for a 110 volt circuit, suitable windings will be furnished for any desired circuit.

The forge itself is well constructed, having a large, heavy cast iron fire pan, with a sheet steel hood for an 8-inch smokepipe, and a detachable sheet steel tank with an extension or tong support. This gives the operator every convenience for a wide range of the work. The tuyere is of the deep fire, anti-clinker type, provided with a controlling ball having three openings, which allow the blast to be directed to any part of the fire bed, and also give a blast distribution which results in quick, even heat penetration with great economy of fuel. The blower gives an adequate air supply through a short, straight blast delivery pipe, in which all joints are eliminated with the exception of the connection between the blower and the tuyere.

CUTLER-HAMMER SELF-STARTING SWITCHES FOR ALTERNATING CURRENT MOTORS.

The Cutler-Hammer Mfg. Co., of Milwaukee, Wis., has developed a line of alternating current motor controlling apparatus, conveniently mounted on slate panels for immediate installation. Different equipments of apparatus are used for various types of alternating motors. The entire line includes apparatus for use with the slip ring type of motor

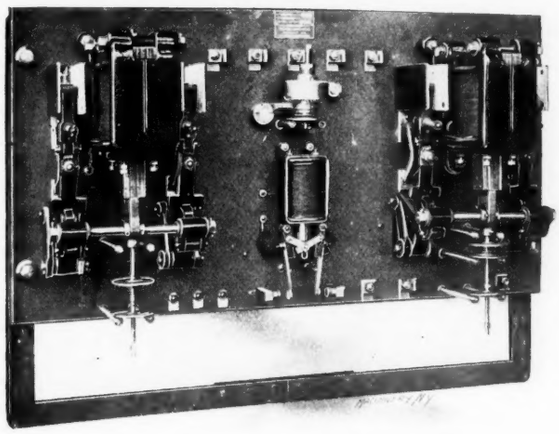


Fig. 1. Self Starter for Squirrel Cage Type of Alternating Motor.

or the squirrel cage motor, and for single, two- or three-phase currents. They may be furnished adapted to the purposes of both manual and automatic operation.

Two examples of this line are shown herewith: Fig. 1 illustrates a self-starter for use with a squirrel cage motor, in such work as driving centrifugal pumps, or similar machines, where the starting torque necessary is materially less than the normal full load torque of the motor, and where the motor will accelerate promptly with a voltage not exceeding 60 per cent of the line voltage. This self-starter is of the multiple solenoid type, and is entirely self-contained. It consists of a slate panel carrying the solenoid switches and relays, which is mounted on a supporting frame with the starting resistance. The primary circuit to the motor for either two-phase or three-phase motors is controlled by a

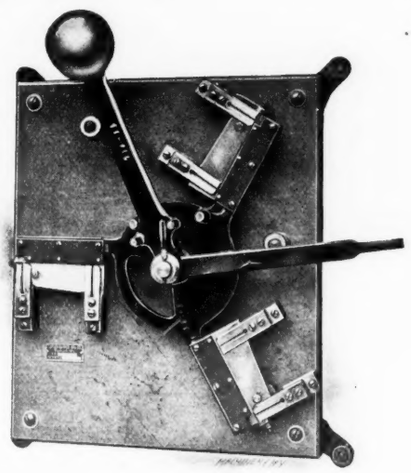


Fig. 2. Automatic Float Switch for Alternating Current Motor.

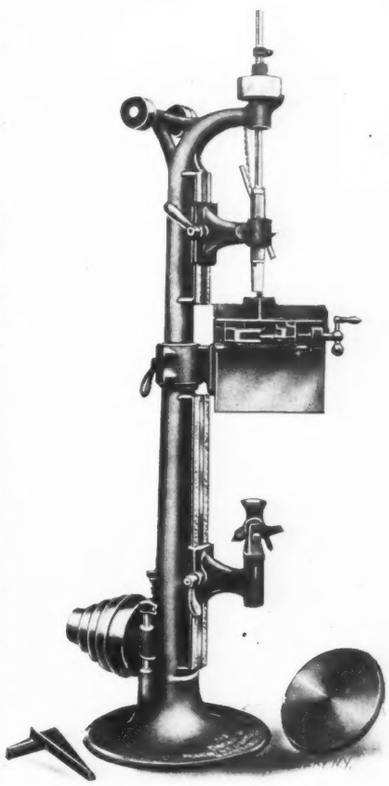
double pole switch in the smaller sizes. The primary switch and starting switch are of open construction, operated by single-phase solenoids. The current carrying contacts are laminated copper brushes pressed against stationary copper contacts by a toggle joint mechanism, insuring a perfect contact. The circuit is always opened and closed at the arcing contacts, which are of carbon and copper and are readily renewable. The starting resistance is non-inductive, and has ample capacity for starting the motor intermittently under light load conditions.

For automatic operation such as is required for electrically driven pumps, which have to be controlled by the water level in a tank, the three pole float switch shown in Fig. 2 may be used, controlling the main line circuit to the motor. It is intended for use only with self-starting, single-phase motors, or squirrel cage type two- or three-phase induction motors, which may be thrown directly across the line to start. No self-starter is required when this method is permissible. As will be seen from the illustration, the float switch consists of a plain slate base with supporting feet carrying the switch parts, weight lever and operating lever. The operating lever is to be connected by a chain or other suitable means to the float in the tank, so that it will be moved up and down the proper distance as the water level in the tank falls and rises. When the operating lever moves the weight lever just past the center, the weight falls the rest of the way and opens or closes the switch with a snap.

ROCKFORD MACHINE & SHUTTLE CO.'S IMPROVED SENSITIVE DRILL.

The Rockford Machine & Shuttle Co., of Rockford, Ill., has improved the design of the sensitive drill shown in the department of New Machinery and Tools in the June issue of MACHINERY. This improvement relates particularly to the drive, the general arrangement of the machine being unchanged.

The driving cone, as shown in the accompanying engraving, is placed near the base of the column, and mounted on a slide which is vertically movable by means of an adjusting screw, to vary the tension on the driving belts. It affects both the countershaft belt and the quarter-turn belt which drives the spindle. This movement gives 3 inches of adjustment, which is sufficient to take care of the stretch for a long time without requiring the belt itself to be shortened.



Sensitive Drill with Improved Drive.

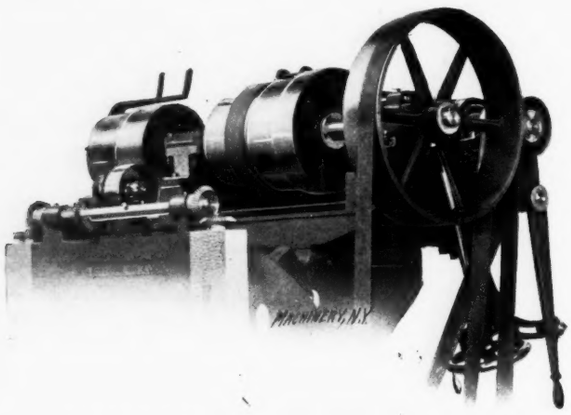
The general features of the machine will be understood by reference to the illustration, where the table is shown tilted vertically and carrying a centering vise. Round stock, resting in the cup centers at the base of the column and held in this vise, is in proper position for centering, making the drill practically a special machine for that work. For regular work, the round table may be substituted for the combined cup, V and solid centers shown. The spindle boxes are adjustable for taking up wear.

GRAY VARIABLE SPEED PLANER DRIVE FOR BELT-OPERATED MACHINES.

In the department of New Machinery and Tools in the December, 1908, issue of MACHINERY, we illustrated and described a self-contained variable speed drive which the G. A. Gray Co., of Cincinnati, O., has developed for use on motor-driven planers. This drive has been adapted to belt-driven

machines as well, and we herewith illustrate the driving mechanism of a small planer thus equipped.

This counter-shaft, as on the larger motor-driven machines, gives four changes of speed, any one of which may be obtained without shutting off the power or stopping the planer; so no time is wasted in making changes. The return speed is constant, being obtained from the primary driving shaft, which is driven directly from the line-shaft by a belt on the tight and loose pulleys shown. The loose pulley is the smaller

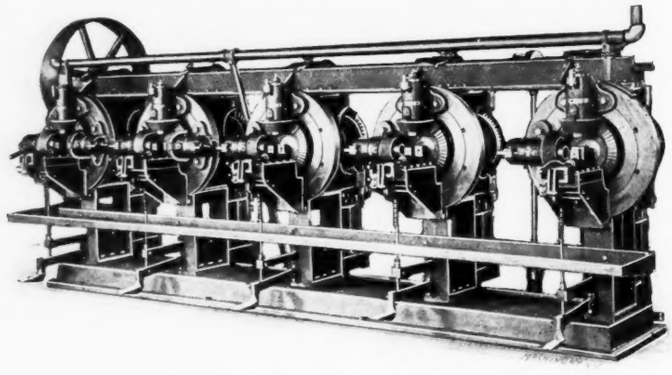


Application of the Gray Variable Speed Counter-shaft to a Belt-driven Planer.

of the two, so that the belt pull is lessened when the machine is not working. The usual beveled shoulder between the pulleys facilitates shifting. The belt shifting fingers for the tight and loose pulleys are universal, and can be set to work properly when the planer stands in front of, or behind, or directly underneath the line-shaft. The handle for controlling this shifting is located at the front of the machine.

POTTSTOWN MACHINE CO.'S AUTOMATIC TAPPING MACHINE.

The Pottstown Machine Co., of Pottstown, Pa., is building an automatic machine for tapping T's, 45-degree L's and



A Gang of Automatic Tapping Machines for T's, Elbows, etc.

similar fittings. The mechanism of the machine is such that its movements are automatic, there being nothing for the operator to do except place the work in the machine and remove it when completed.

From two to six machines may be mounted on a single base as shown. Any one of these may be started, stopped or adjusted without interfering with the other. The work is held in a vise having jaws of suitable form to center the work with the tapping spindles. These are carried in heads which are adjustable about a circular face, as shown, to any position on the quarters, or on the intermediate 45-degree angles. From one to three heads for each piece may be employed as required. The tapping spindles are arranged to make a definite number of revolutions, adjusted to agree with the length of thread to be cut. This adjustment may be made by even quarters of a revolution while the machine is in motion. It is stated that the reversing motion is so positive that the tapping depth is accurate within 1/16 of a revolution. This insures a high degree of uniformity in fit in the finished threaded joints.

The driving mechanism, when the depth has been reached, stops and returns the spindle automatically, when it again stops, waiting for the operator to remove the work. There is thus no danger of injury in the way of getting the fingers caught in the mechanism. When the new work has been clamped in place, the machine is started by a foot lever after the operator has left the working position.

GLOBE MACHINE & STAMPING CO.'S KEROSENE OIL BURNER.

The Globe Machine and Stamping Co., 974 Hamilton Ave., Cleveland, O., is manufacturing a kerosene oil burner under patents of John A. Mathes, a California inventor. It is designed to fill a wide field of industrial uses, where the installation is not so large as to warrant putting in an independent gas plant. For most industrial work the artificial gas is too expensive, and coal or coke is not convenient or efficient, and requires constant attention. The new burner, using kerosene oil is thus adapted to the heating of drying ovens, heat-treating furnaces for steels, enameling ovens, water heating apparatus, and numerous other industrial purposes.

A Gravity-fed Burner for Kerosene Oil.

As compared with other forms of apparatus for burning oil of various kinds, this apparatus does not require a forced blast, and does not use an atomizer of any kind. The oil is atomized by heat under conditions that prevent the deposition of carbon in the vaporizing chamber. There is thus no interference with the operation of the burner. The burner does not require pressure pumps for forcing the oil, which is fed to it from a reservoir or barrel placed about 10 feet above the level of the burner. The construction is the simplest possible and the flame is controlled with all the ease of a gas burner. The flame resembles very much that of natural gas. Three of these burners in a brick oven about 4 by 5 by 15 feet (300 cubic feet) heat the oven to a temperature of 1,000 degrees Fahrenheit, and consume collectively about four gallons of oil per hour. Five natural gas burners consuming about 700 feet of gas per hour were required to do the same amount of work. It will thus be seen that the cost of operating this burner on kerosene oil (a fuel obtainable anywhere) puts its use practically on a par with that of natural gas.

ROCKFORD COMBINED DRILLING AND TAPPING MACHINE.

The bench drill, and the 12- and 14-inch drilling machines manufactured by the Rockford Drilling Machine Co., of Rockford, Ill., are now provided (if desired by the customer) with a tapping mechanism of unusual convenience, built into and a part of the machine itself. The construction of the device will be understood after a study of the accompanying engraving and description.

For drilling, the usual bevel gear connection is made between the horizontal cone pulley shaft and the spindle. The quick reverse for tapping is driven from a separate bevel gear face on the driving bevel pinion on the cone shaft. This

rear bevel face meshes with an intermediate gear on a vertical stud in a housing at the top of the frame. An intermediate spur gear is keyed to this, which in turn meshes with a spur pinion on a sleeve surrounding the upper end of the spindle. The clutch playing between the bevel gear and spur pinion on the spindle thus serves to engage it with either of these gears, giving a forward movement in one direction and a quick reverse in the other.

The operation of the machine for tapping is very simple. The clutch lever on the right-hand side of the spindle is so located that the operator can control it by the thumb and the forefinger of the right hand, which at the same time grasps and operates the knurled hand-wheel which controls the feed. The operator is then free to use his left hand to hold the work, and to rapidly change the pieces. The intermediate gears of the tapping device are mounted on an upright movable shaft which, when lifted up, disengages these gears from the rear bevel face on the wheel drive shaft. When the gearing is thus disengaged the machine is free for straight drilling at high speeds. The tapping mechanism may thus be instantaneously engaged or disengaged without requiring the operator to move from his position.

Rockford Drilling Machine with Built-in Tapping Attachment.

This mechanism has the advantage over the ordinary removable or portable tapping attachment in allowing the work to be done at the normal height. When the usual attachment is used, mounted in the spindle by a tapered shank, the operator is required to hold his work six or eight inches below the natural level. The builders state that they are preparing to furnish this arrangement in modified form to suit their entire line of upright and gang drills.

HOB SHARPENING ATTACHMENT FOR THE WALKER UNIVERSAL GRINDER.

In last month's issue of MACHINERY, in the department of New Machinery and Tools, we described certain improvements in the universal grinder built by the Walker Grinder Co., of Worcester, Mass. These improvements related particularly to the method of mounting the wheel spindle universally so that it can be swiveled to any angle about a vertical or horizontal axis. This universal adjustment is obtained through a wide range in every direction, without any difficulty in the belt drive, which is so arranged that the belt passes freely over the various driving and idler pulleys without change of tension, and without tending to crowd against the flanges. This spindle drive has made possible an ingenious and effective hob sharpening attachment (see Fig. 1) which is the subject of this description.

Method of Grinding Hobs and other Formed Cutters.

To understand the principle of this device it will first be necessary to examine the different methods that are employed for sharpening hobs or other form cutters. The common way of doing this is shown in Fig. 2. The face x of the wheel is trued up to a plane at right angles to the spindle

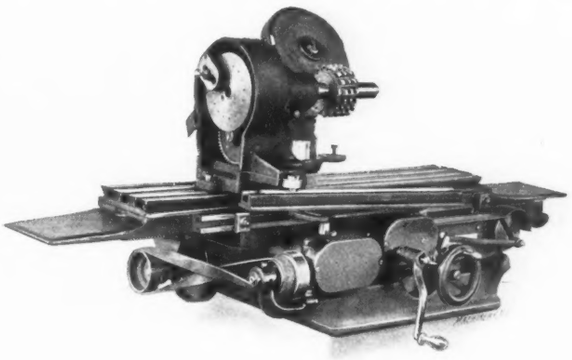
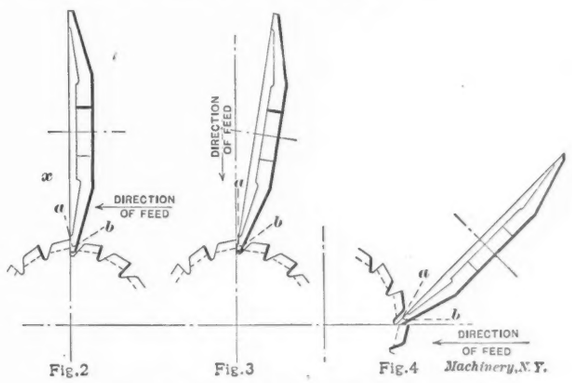


Fig. 1. Hob Sharpening Attachment for the Walker Grinder.

axis. This face is fed against the cutting face of the hob tooth, the feed movement being in the direction of the arrow. The face of the wheel covers the whole surface of the tooth as the work is passed back and forth in front of it. The difficulty of obtaining good results by this method lies in the fact that the wheel wears away (as it must to cut freely and effectively), and as the outer corner is subjected to the most severe duty, it wears away fastest. The wheel thus tends to assume the shape indicated by the dotted line $a\,b$, which is obviously not fitted for giving the proper shape to the cutting edge.

The better procedure is shown in Fig. 3. Here the grinding spindle is tilted so that the flat surface of the wheel clears the work; the wheel is set to the proper depth of cut and then fed downward as shown by the arrow, until the bottom of the groove is reached. This is much more satisfactory than the first method, producing a flat radial cutting edge until the wheel has worn back beyond line $a\,b$. The principal objection to this method of grinding lies in the fact that it requires a vertical feed, which is inconvenient for any ordinary design of grinding machine.



Figs. 2, 3 and 4. Various Methods of Sharpening Hobs and other Formed Cutters.

The objections applying to the other two methods are obviated by the process shown in Fig. 4, which is employed in the Walker grinder. Here the face of the tooth to be ground is placed on a horizontal plane, and the grinding spindle is set at the proper angle to conform to the shape of the groove in the cutter. The radial face of the tooth is thus surface ground by the beveled periphery of the wheel; and by referring to line $a\,b$, it will be understood that the wear of the wheel simply reduces its diameter and slightly rounds its outer corner, without affecting the finished surface. The feed is horizontal as shown. Other advantages

of this method are a reduction in the heating effect, the possibility of grinding into a sharper corner, and of grinding a spirally grooved cutter. This is impossible by either of the other two methods, as plain surfaces do not clear spiral grooves readily. There is no difficulty on this score with the beveled cutting face in Fig. 4. The Walker grinder has

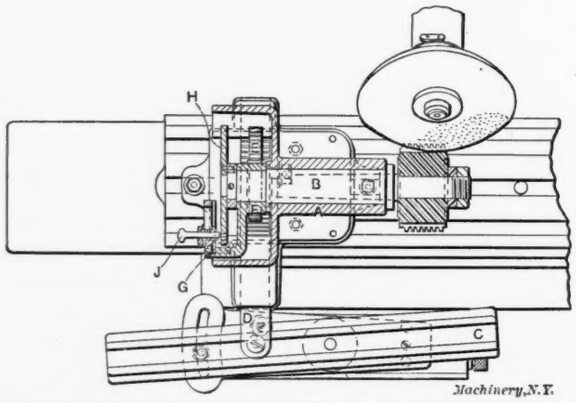


Fig. 5. Plan View of Hob Sharpening Device with Helical Attachment.

been designed to permit the placing of the wheel in the particular position required for grinding spiral hobs properly.

The Hob Sharpening Attachment.

The mechanism of this attachment is shown in detail in Figs. 5 and 6. The stand *A*, fastened to the top of the grinder table, carries work spindle *B*, which is provided with a tapered hole for receiving the hob or cutter arbor. For hobs with spiral grooves a mechanism is provided for rotating the work in unison with the longitudinal table movement. This rotation is governed by a swiveling bar *C*, identical in construction with that used on lathe taper attachments. The block sliding in this guide is pivoted to the end of cross-bar *D*, which thus receives a greater or less cross movement in unison with the table, depending on the angle at which the slide *C* is set. Rack teeth cut in *D* engage intermediate gear *E*, which in turn meshes with pinion *F* on the spindle. For grinding straight grooved hobs or cutters, the bar *C* is set parallel with the table movement.

The indexing mechanism is plainly shown in Figs. 5 and 6. Pinion *F* is not keyed to spindle *B*, but is part of arm *G*, which carries the index pin, *J*. The index plate *H* is keyed to the spindle. The index pin may be adjusted radially to line up with any particular row of holes in the index plate. The latter may be changed to give any required indexing. It will thus be seen that the rotary movement for the spiral attachment is transmitted from cross-bar *D* to intermediate gear *E* and pinion *F* to index arm *G*, and thence through pin *J* and plate *H* to the spindle *B*.

Method of Setting up the Machine.

Figs. 7 and 8 show the arrangement of the machine for grinding right- and left-hand teeth respectively, when the cutter, as would be the case if made with a solid shank, cannot be reversed in the spindle. The arrangement for the right-hand teeth in Fig. 7 is the same as in Fig. 4. For left-hand teeth the cutter spindle is tipped to the corresponding position below the horizontal, and the grinding is done on the under side of the tooth face, as shown in Fig. 8. This latter illustrates the flexibility of the spindle drive provided.

It is understood, as explained in connection with Fig. 4, that the face of the cutter tooth is thus finished by a surface grinding operation, using the automatic cross-feed in the regular manner. The sharp corner of the grinding wheel is maintained by the wear of the periphery. There is practically no danger of drawing the temper of the cutter, and when the tooth is ground it presents a keen edge, without discoverable evidence of round edges and other imperfections.

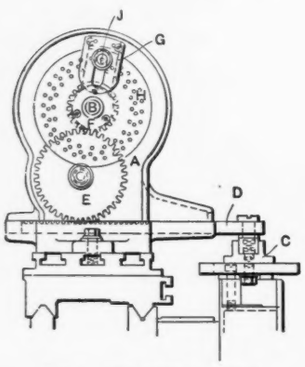


Fig. 6. End View of Device.

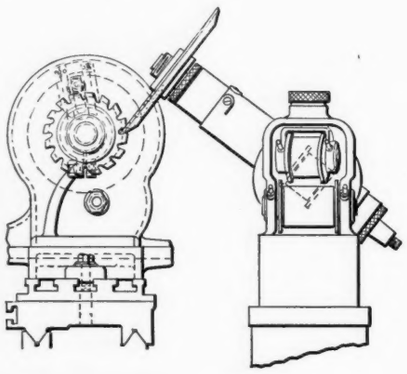


Fig. 7. Arrangement of Machine for Grinding a Right-hand Hob.

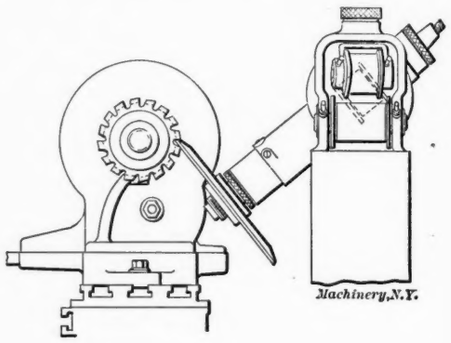


Fig. 8. Arrangement for Left-hand Hob.

HELWIG PNEUMATIC CHIPPING AND RIVETING HAMMERS.

The Helwig Mfg. Co., St. Paul, Minn., is building the hammer illustrated herewith. It is designed to meet the severest requirements for tools of this kind, being of large capacity, simple design, substantial construction, convenient of manipulation, and low in cost of operation and maintenance.

The handle is drop-forged and of the closed type, having a shape conforming to the grip of the hand. The locking device makes it impossible for it to get loose on the barrel. The hose connection is at right angles with the barrel, making it more convenient to handle and lessening the pull of the hose on the operator. It also gives more clearance in close quarters, and obviates wear and tear on the hose and the threaded connections.

The valve chamber is hardened and ground, and solidly bedded in the barrel, though it is easily removable. The whole valve mechanism is very simple. The valve is balanced and of the positive type, with a large wearing surface. As it operates in the same direction as the piston, the wear on it is reduced to a minimum, and the full power of the air is utilized for effective work, instead of being wasted in overcoming friction. The piston is a solid piece of tool steel,

Helwig Chipping Hammer.

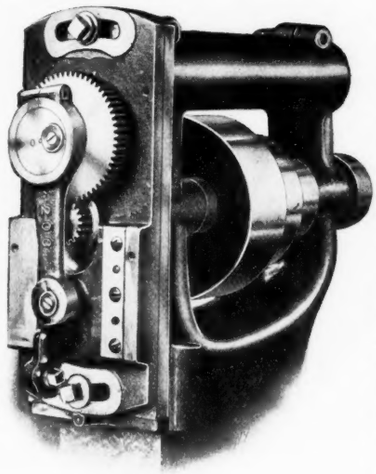
also hardened and ground. The construction is such that the operator does not feel the hard metallic blow met with in some tools of this kind. This lessens his fatigue and increases his efficiency. The hammer will not operate unless the chisel is in place.

This tool is made in a wide variety of sizes and capacities, both for chipping, calking and beading, and for riveting. To

illustrate the power of the tool, it is said that the 4-inch stroke riveting hammer, weighing 11 pounds, will drive ¾-inch rivets steam tight.

SLOTTING ATTACHMENT FOR THE BURKE MILLING MACHINE.

The accompanying illustration shows a back-geared slotting attachment designed by the Burke Machinery Co., 1837 Thirty-fifth St., Cleveland, O., for use with its No. 3 and 4 milling machines. One of the novelties in the construction of this attachment is the geared drive, which makes heavy cuts possible on a high speed miller.



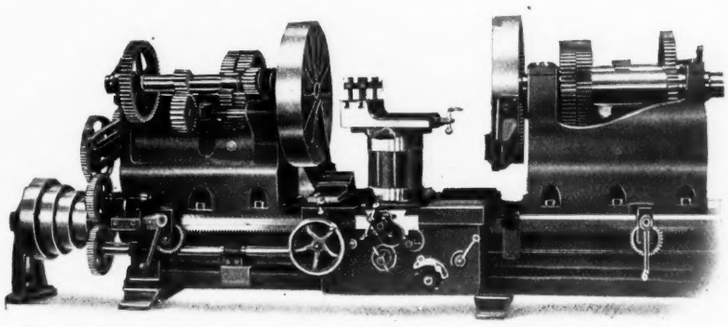
Back-geared Slotting Attachment with Gear Case removed.

The attachment is clamped to the face of the column, and to the over-hanging arm support, making it, for all practical purposes, a part of the machine. The guides for the slide swivel on this support about the axis of the driving pinion, to any angle up to 10 degrees either side of the center. The graduated dial for reading this adjustment, and the bolt for clamping the slide to the desired angular position, are clearly shown in the engraving. The stroke is one inch. The device weighs, complete, twenty-three pounds.

FAY & SCOTT DOUBLE-HEAD FACING LATHE.

The 62-inch double-head lathe shown herewith is a combination of facing machine and lathe. It is particularly designed for use in facing flanges, girders and similar work held in stationary fixtures on the bed. For this purpose it is provided with facing slides and tool-holders on the faceplates. It is also adapted to the boring of cylinders by means of a traveling head boring bar. The machine was constructed from the stock parts of the builders' regular 38-inch standard lathe, raised to swing to 62 inches over the bed, and 50 inches over the carriage.

The machine is fitted with a regular carriage, having an extension for the extra swing; it is provided with the usual feeds and screw cutting features, making the machine available for ordinary lathe work. The head-stocks are each adjustable lengthwise of the bed by a rack and pinion movement; they may be clamped in any position to suit the work in hand. The facing heads, which also form the faceplates of the lathe, are driven by the usual triple-geared mechanism, being provided with internal gear teeth in their rims engaging driving pinions in the head-stock. Each head-stock is driven from a spline shaft passing through the center of the bed. The spindles run in opposite directions to equalize the strain on the work.



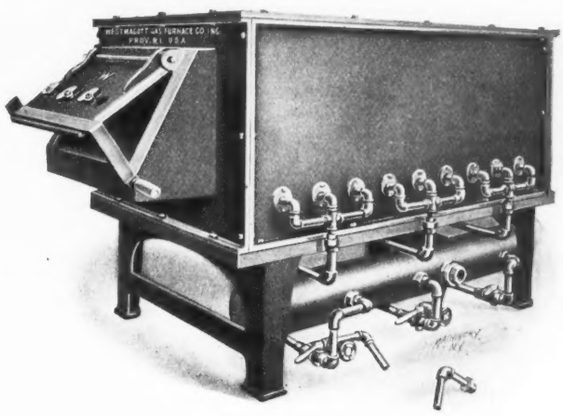
A Modified Lathe, adapted to Facing and Boring Work mounted on the Bed or Carriage.

The back gear ratio is 12½ to 1; the gear ratio with the triple drive into the faceplate is 40 to 1. The maximum distance between the facing heads with a 22-inch bed is 13 feet. The weight is 24,000 pounds. The builders are Fay & Scott, Dexter, Me.

WESTMACOTT HARDENING AND ANNEALING FURNACE.

The accompanying engraving shows a hardening and annealing furnace recently furnished by the Westmacott Gas Furnace Co., Inc., of Providence, R. I., to the Rock Island Arsenal. It is notable for the small gas consumption due to a new style of burner with which it is equipped.

The furnace is intended for annealing and hardening carbon steel, the maximum temperature required being 1,600 F. The space to be heated is 62 inches long and 26 inches wide. Nine burners on each side are provided, or eighteen in all. These are divided into three sets of six each, controlled independently, as shown in the engraving. The furnace operates satisfactorily on about 425 cubic feet of gas per hour; the fuel in this case has a richness of about 425 B. T. U. per cubic foot, and the air pressure is 1½ pound per square inch. The net weight of the furnace is 6,500 pounds.



A Hardening and Annealing Furnace, which shows great Fuel Economy.

CUTLER-HAMMER ALTERNATING CURRENT DRUM CONTROLLERS.

The Cutler-Hammer Mfg. Co., of Milwaukee, Wis., has recently developed a line of drum controllers for use with two- or three-phase slip ring motors, operating cranes, hoists, and other classes of machinery which require frequent starting or stopping. Both the drum and resistance are rated for intermittent duty not exceeding 150 per cent of the motor rating, for both primary and secondary circuits; and they are designed to reduce the motor speed 50 per cent under average load conditions. Where the service is exceptionally severe, or where special specifications are to be met for which the standard controller may not be suitable, the builders are prepared to give estimates on special equipment.

The drums consist of a three-pole primary, combined line and reverse switch, with a cylinder for controlling the secondary starting and regulating resistance, mounted on the controller shaft and driven directly by the operating lever. For all sizes of drums the secondary resistance controller is of open construction. For the types A, B and C drums the primary switch is also of open construction, but for the types D and G drums the primary switch is immersed in oil. The A, B and C drums are arranged for wall mounting, but the D and G drums are for floor mounting, in order to provide properly for the oil tank containing the primary switch. The installation of the latter should provide space for the removal of the oil tank for connecting and inspection. The drums are constructed of the best materials throughout. All contacts

and brushes are made of hard drawn copper and are easily and cheaply renewed. The contact segments are firmly mounted on a metal cylinder, which remains perfectly true under all climatic conditions. The oil tanks for the types D and G drums are of seamless steel and will not leak. These tanks should be kept full of a clear mineral oil. Machine oil must not be used.

Resistance is provided in each of the three phases of the motor circuit, mounted in comparatively small frames for

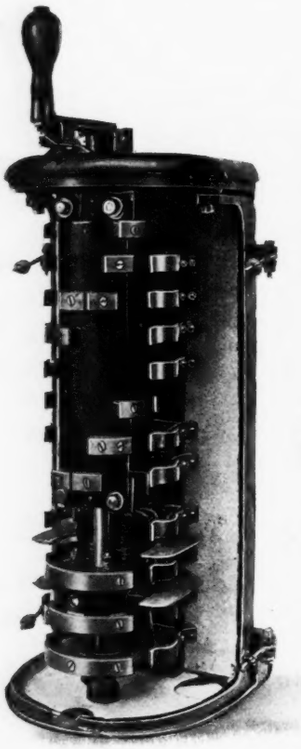


Fig. 1. Reversible Drum Controller for Alternating Current.

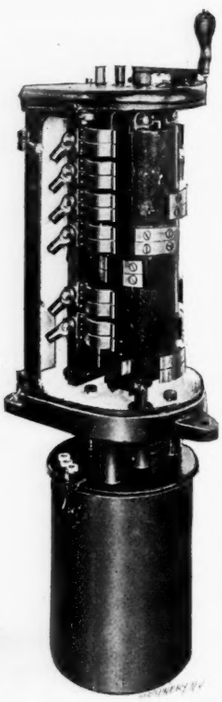
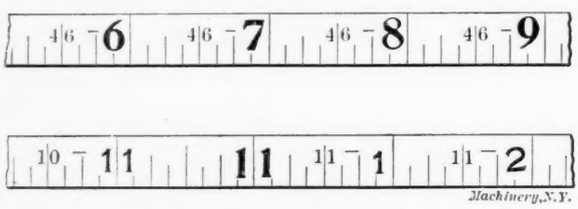


Fig. 2. Drum Controller with Oil Tank for Primary Switch.

convenient installation. Except for the small sizes, the resistance is of the cast metal grid type. The resistance is as compact as possible, consistent with ample capacity for intermittent regulating duty.

LUFKIN STEEL TAPES FIGURED FOR INSTANTANEOUS READING.

The accompanying illustration shows at a glance the nature of an improvement in the figuring of steel tapes, which has been devised by the Lufkin Rule Co., of Saginaw, Mich. Everyone who uses a long tape has suffered the inconvenience which arises from the fact that the number of the feet is only registered at the end of each 12 inches. When an exact



Instantaneous Reading Graduations for Steel Tapes, giving both Feet and Inches.

measurement is required which comes between two foot marks, it is necessary to first ascertain the number of inches, and then go back carefully to discover the last registered foot.

The improvement consists, as may be seen, in printing the number of feet in smaller figures, at each inch mark, immediately preceding the number of inches. This makes it possible to read without risk of error the exact measurement at any point. On the upper tape, for instance, the dimension 46 feet, 7½ inches may be read at a single glance. A common error is that of reading 11 feet, when the figures for 11 inches immediately precede the figure for 11 feet. No such error in reading can occur with this new form of "instantaneous readings," as the makers term it, as may be seen in the lower section of tape in the engraving. This form of dimensioning will be furnished without extra charge on all steel tapes made by this firm of ¼- and ⅜-inch width, up to 100 feet long. The design is patented.

BEMIS & CALL ADJUSTABLE SQUARE-JAWED AND PIPE WRENCH.

The well-known "S" square-jawed wrench and the corresponding pipe wrench made by the Bemis & Call Hardware & Tool Co., of Springfield, Mass., have been combined in the form shown herewith. This combination wrench at the present time is made only in the 6-inch size. It is particularly adapted for automobile and gas engine use. The sliding jaws are provided with full bearing on the frame when

Adjustable Combined "S" Pipe and Nut Wrench.

opened to their widest capacity. The parts are all carefully hardened and tempered for the duty expected of them. The operating nuts of these wrenches are of steel and the sliding jaw is a steel drop forging, notched on the pipe wrench side with teeth for engaging the pipe. It will be found useful for turning pipes or unscrewing bolts and nuts in confined places, such as corners or close to walls. The price of the single pipe wrench has lately been reduced to agree with that of the square jaw style.

DELTA NEW CUT FILE FOR SAW SHARPENING.

A file specially designed for saw sharpening is being made by the Delta File Works, Carver File Co., Philadelphia, Pa. This file is made on a slim tapered blank in lengths from 4 to 10 inches. The tang is drawn without a shoulder, and the lines on the edge of the file run parallel until very close to the point, where they taper very sharply. The angle of the tooth is made more acute by 10 degrees than that ordinarily used for saw files. This enables more teeth to the inch to be cut, and also strengthens the edge of the file. This edge receives the brunt of the work in saw filing, as it is in action in the gullet at every stroke removing more stock than the side of the file. These improvements combine to give the tool a high efficiency. The makers have reports of tests in two different saw factories giving records of the filing of as many as eight saws with one file.

AMERICAN BLUE-PRINT PAPER CO.'S REPRODUCTION PROCESS.

The American Blue-Print Paper Co., 294 Dearborn St., Chicago, Ill., announces the introduction of a new process of printing by means of which reproductions may be made from black line, blue line or any color print, directly on drawing paper, cloth, tracing paper or cardboard as quickly as blueprints are made. Tracings may be reproduced on cloth or paper, which will be fac-similes of the original and true to scale; there is no difficulty from shrinking as is the case when the reproductions have to be washed in water and dried. The new prints are flat and permanent. The lines do not fade nor the background turn yellow. The body of the paper or cloth is not coated with an acid solution as is in other processes, so that it is in the same condition as when received from the manufacturer. It is stated that the black prints made with this process are jet black and not dark brown like

those made from negatives. Any part of the original not wanted in the reproduction can be blocked out without damage to either original or reproduction.

This process is an extremely rapid one. The firm mentioned above has such facilities for the work that all orders sent are shipped the same day the tracings are received, so that the work is practically done as quickly as though it were not sent out. The process has not been as yet developed for individual use by customers, as it requires unusual care and experience. The demand for prints made in this way has been so great as to severely tax the equipment of the manufacturers.

NEW DESIGN OF LEA SIMPLEX COLD METAL SAW.

The Lea Equipment Co., 136 Liberty St., N. Y. City, has recently re-designed the "Lea Simplex" cold metal saw, introducing important improvements, particularly in the feed mechanism. The machine as a whole is shown in Fig. 1, while the new mechanism is seen in detail in Fig. 2. The general arrangement of this saw is well known. The blade is driven by a pinion whose teeth mesh with slots cut in the blade itself near its periphery, thus giving a drive nearer the cutting point of the saw than can be obtained by other methods. This drive also gives a maximum of capacity for a given diameter of blade, as no clearance for the driving

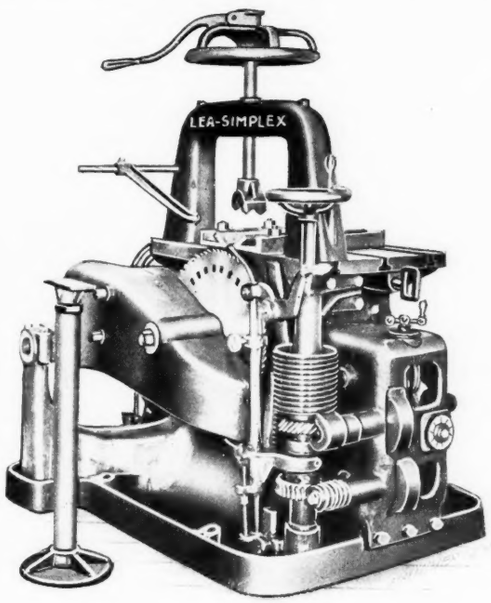


Fig. 1. Lea Simplex Cold Saw with Improved Feed Mechanism.

gear on the spindle has to be allowed for. The saw arbor, blade, and driving mechanism are mounted on an arm which is swung upward about a pivot at the rear, to feed the saw into the work.

As shown in Fig. 1, the swinging arm which carries the saw is fed upward in the new design by a worm of large diameter, engaging a segment of a wormwheel clamped to the arm. This worm is driven from a feed-box by either the spiral or worm gearing shown. The former is used for the quick return, while the latter is operated by the variable feed mechanism. The feed mechanism (see Fig. 2) is driven by a sprocket and chain from the driving shaft at the rear of the machine. This sprocket is mounted on the constant speed shaft of the gear-box, which drives the feed worm directly through spiral gearing, as previously mentioned. On this same shaft is mounted the first member of a Sellers friction drive. The intermediate member, with the two beveled, spring-pressed disks, is mounted on a swinging sector below it, while the driven member is mounted on a third shaft at the bottom of the feed box. The intermediate member is swung up or down, thus increasing or diminishing the feed, by means of a screw and ball crank shown projecting through the case at the top. The rate of feed is indicated by a dial at the front of the box as seen in Fig.1.

This improved mechanism takes the place of an older friction cone arrangement, which sometimes gave trouble from oil on the bearing surfaces. The Sellers disks are unaffected by oil. The intermediate disks are made of soft steel, while the driving and driven members are of bronze. The sides of the intermediate disks which bear on the bronze disks are beveled to an angle of about two degrees. When the operator grasps the knob on the intermediate disk shaft, which projects through the side of the casing, this action screws up a spring and increases the pressure on the bearing surfaces. An automatic stop and reverse are provided for the feed mechanism, controlled by an adjustable dog, as shown in Fig. 1. Both the worm and spiral gear shafts are fitted with roller thrust bearings.

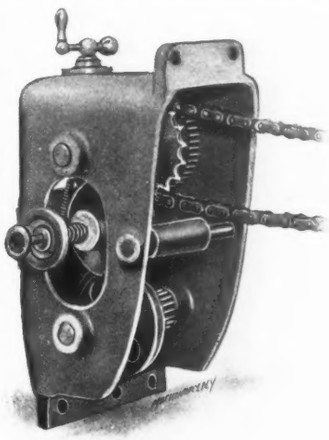
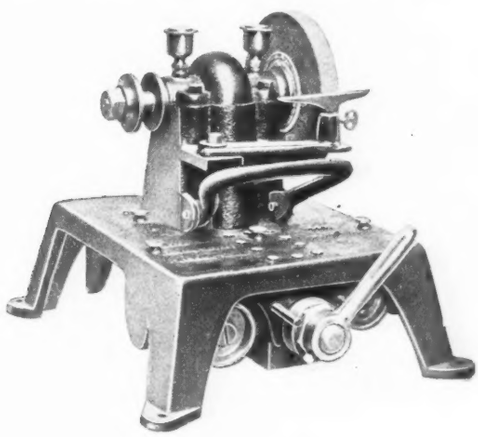


Fig. 2. Detail View of Feed Box, showing Sellers Drive.

Another improvement made on this machine relates to the form of V-block used. This is adapted to holding either round or square stock, as it is made in two sections which may be reversed if required. It is shown in place on the table in Fig. 1. In cutting round stock the two tapered edges are put together, allowing the stock to rest almost in contact with the table. In cutting square stock, the two castings are turned end for end, thus practically making two knee plates. The holes by which the blocks are bolted to the table are lengthened to form slots, so that the blocks may be swiveled to 45 degrees, permitting angular cuts to be taken.

HELWIG PORTABLE PNEUMATIC GRINDER.

The portable pneumatic grinder built by the Helwig Mfg. Co., of St. Paul, Minn. (shown in the accompanying engraving), is intended for use in railroad shops, shipyards, and places where structural erection is going on, and for other



A Portable Air-driven Grinder for Tool Sharpening.

places where there is more or less grinding to do. It saves the time and labor required for carrying tools back and forth to the shops.

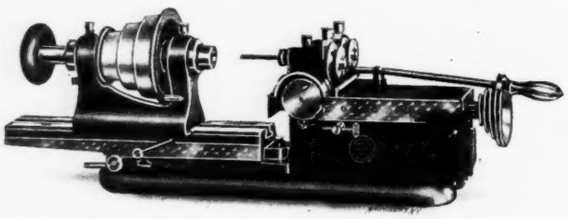
The grinder has a handle by means of which it may be carried from place to place; and it is provided with a clamping device for fastening it to an I-beam, angle iron or other support, convenient to the workman. The tool is made in two sizes. No. 1 weighs 130 pounds, requires 18 by 20 inches of floor space, and may be equipped with two wheels up to 1½-inch

face and 10-inch diameter. No. 2 is smaller, taking a ¾- by 6-inch wheel, and occupying 12 by 15 inches of floor space.

WALTHAM AUTOMATIC INTERNAL GRINDING MACHINE.

The Waltham Machine Works, Newton St., Waltham, Mass., is building the automatic internal grinding machine illustrated herewith. This machine is adapted for grinding holes, from the smallest size up to an inch in diameter. The only limit in size for the minimum hole is that of the smallest practicable diamond charged lap. This machine has the advantage of a drive which permits the maintaining of extremely high spindle speeds; and the further advantage of automatic action, which permits two or more of them to be taken care of by one operator.

The bed of the machine carries ways for the grinding slide at the right, and is provided at the left with an extension on which is mounted the work-carrying head. This can be swiveled from 0 to 45 degrees, and by means of a micrometer screw, readings to minutes may be easily obtained. The swiveling plate has ways of the same profile as the builders' regular 8-inch bench lathe, so that the 8-inch head-stock may be used. The machine can be made, if desired by the purchaser, to fit the head-stock of any other similar lathe, providing standards are furnished for fitting. If the machine is to be used continuously, a special head-stock is recommended, made to take spring chucks. The bed is long enough to permit the use of a back-rest, so that straight or taper holes in the end of small spindles can be accurately ground.



A Precision Internal Grinder with Friction Spindle Drive.

The reciprocation of the grinder head slide on the bed is effected by a cam and slotted link movement, which can be altered to any desired length of stroke within the range of the machine (from 5/16-inch to 2 inches), and to any convenient number of strokes per minute as determined by the cone pulley which drives this mechanism. The cross-slide on which the wheel spindle is mounted is provided with an automatic feed. This is operated by a ratchet mechanism which strikes the adjustable knurled screw seen at the front of the bed in the engraving. By altering the adjustment of this screw, any feed from 1/15,000 to 1/1,500 inch can be given at each stroke of the slide. A stop is provided which throws out this cross movement when a predetermined diameter has been reached. The cross-slide can be withdrawn from alignment with the work by a lever, so that the diameter of the work can be more easily measured. Springs return the cross-slide to exactly its original position.

Two styles of grinding head are made, either one or both of which will be furnished as desired. The high-speed head is shown in the illustration. In this a small straight spindle is driven by two friction disks, mounted on each side of it. The two driving pulleys for these disks are plainly shown. The belt from the countershaft passes down under both of these pulleys and revolves them in the same direction. The friction disks attached to the pulleys spin the grinding spindle between them in the same way that a pencil might be spun between the thumb and forefinger. This method would appear to permit a much higher speed than could be maintained with a belt-driven spindle. Since the belt itself runs comparatively slow, it may be larger and of more durable construction than would be possible if it drove the spindle directly. For larger work where slower speeds can be used, a plain direct belted grinding head is used. On both styles provision is made for maintaining vertical alignment.

CHANDLER'S ADDING AND SUBTRACTING SCALE FOR FRACTIONS.

The device shown herewith for adding and subtracting fractions and their decimal equivalents, has been placed on the market by James S. Barron, Barron Building, New York City. The scale is formed by two celluloid disks pivoted at the center, and each provided with two rows of concentric graduations, one of which gives the common fractions and

A Circular Slide Rule for Adding and Subtracting Fractions and their Decimal Equivalents.

the other the decimal equivalents. The fractions are located on the upper and lower disks, and when two of them are to be added, the disks of the circular slide rule are shifted to bring these two fractions together. The sum will then be found opposite the notch cut in the small disk. Both the fraction and the decimal equivalent are displayed, the latter showing through the notch on the lower scale. For subtraction, the slot on the small disk is set opposite the minuend, when the answer will be found on the large disk opposite the subtrahend on the small disk. The instrument is made of celluloid, so it may be washed whenever it gets soiled. It should prove a very useful device, particularly for draftsmen, machinists, tool-makers, etc. It is sent postpaid to any address for $1.00.

MOHN UNIVERSAL VISE FOR DRILLING, MILLING, ETC.

The universal vise for holding work for drilling and milling operations, etc., shown herewith, is built by W. D. Mohn & Co., Reading, Pa. The simplicity of its construction is at

A Simple Adjustable Vise for Drilling, Milling, etc.

once apparent, particularly in the matter of setting for drilling angular holes. This is effected by a rod, which may be extended more or less to tip up the vise to the angle required There are no loose parts, as even the wrench is permanently mounted in place on the screw.

The base of the tool has a ledge on all four sides, so that it may be clamped securely to a machine table from any side without springing either the vise or the machine. The front side in the view shown in the illustration is machined, so that the vise may be set on edge. The sliding jaw has a vertical groove (which does not show plainly in the illustration) for holding round work. The handle is carefully proportioned to allow firm pressure to be brought to bear on the work, without danger of an excessive strain, the handle having a length proportioned to the size of the vise. The screw and nut cannot be ruined by an attempt on the part

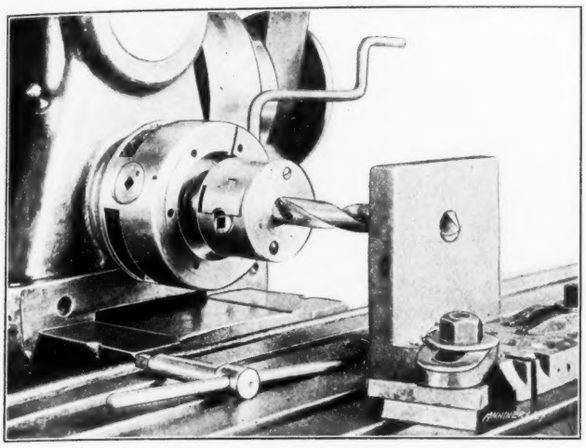


Fig. 1. Casler Eccentric Boring Head, Centered for Drilling.

of the workman to increase the leverage by a piece of pipe stuck over the end of the handle, as this is bent at right angles, as shown, to prevent such abuse.

The tool is made in three sizes. The smallest has a jaw 3½ inches in width and 1 inch deep, giving a maximum opening of 2 inches; the weight is 6½ pounds. The largest size has a jaw 6½ inches wide and 1¾ inches deep; the maximum opening is 6 inches, and the weight is 45 pounds.

CASLER ECCENTRIC BORING HEAD.

The eccentric boring head, illustrated herewith, is designed to be fitted to milling machines, drill presses, boring machines and lathes, and is used to bore holes accurately and to size on any class of work where it is convenient to hold the work stationary, rather than to fasten it to a rotating spindle. It is particularly adapted for use on milling machines, in laying out and boring holes in jigs and tools. It saves time in that it offers means for making minute adjustments quickly and surely, without the uncertainty of adjust-

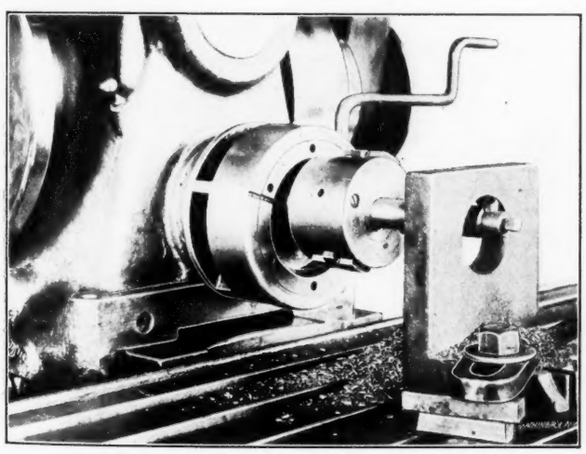


Fig. 2. Enlarging the Drilled Hole with a Boring Tool.

ment found in using a boring bar with an inserted cutter held by wedges or set-screws. It is a difficult matter to adjust such a cutter with a hammer to exactly the right diameter.

Figs. 1 to 4 show the device in use and Fig. 5 shows its construction. The tool consists of a body *A*, which is threaded to the spindle *B* of the tool on which it is used. The outer face of this body is recessed to receive a plate *D* into which is threaded the tool-holding chuck *C*. *D* is of smaller diameter than the recess in which it is laterally adjustable, so that the chuck may be set at any position

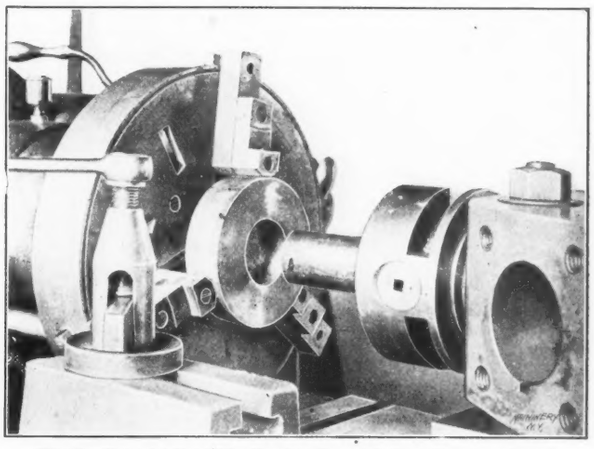


Fig. 3. Use of Adjustable Head in Turret Lathe; Chuck replaced by Heavy Boring Tool.

from exact concentricity with the center line of the spindle to the maximum offset shown by dimension *F* in the face view. This latter adjustment is controlled by a screw in the side of the body *A*. The head of this screw is provided with graduations reading to 0.001 inch, and has a squared socket so that it may be operated by the chuck wrench. It is not shown in Fig. 5, but may be seen plainly in Figs. 1 and 3. When the adjustment has been made, the floating disk *D* is clamped by screwing down the threaded ring *E*, firmly binding the whole head together.

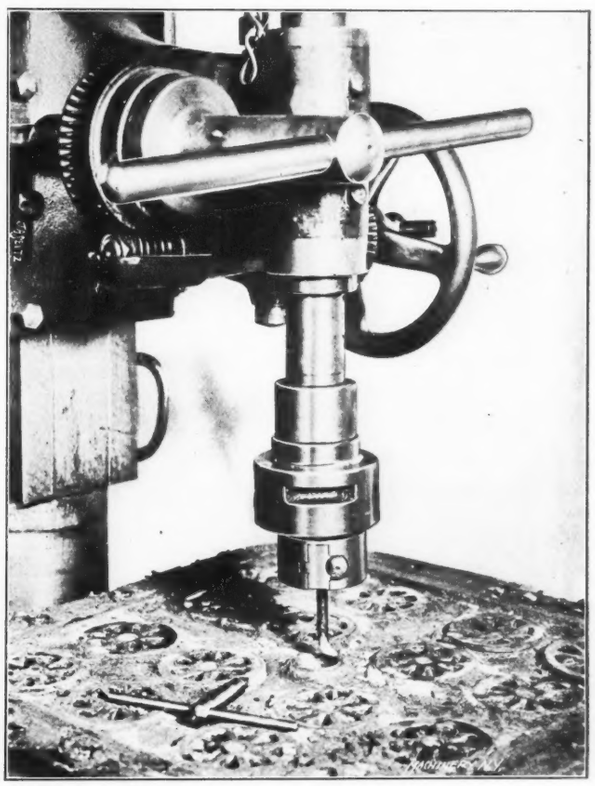


Fig. 4. Boring Head in Use on Drill Press.

In using the tool for boring moderate sized holes, the drill chuck is first set concentric with the boring head, and the ordinary twist drill is used in the chuck to start the hole, as in Fig. 1. After the hole has been brought nearly to the size by the use of twist drills, the drill is replaced by a tool with a single cutting point, similar to a lathe boring tool (see Fig. 2). By means of the offset movement of the drill chuck, this tool is easily brought to the proper position to

finish the hole to the required diameter. But very few tools are required for a wide range of work, for the reason that the difference between the minimum and the maximum diameters, which any tool will cover, is equal to four times the offset (*F*) of the boring head.

In cases where a tool which could be held in the drill chuck would not be heavy enough, the latter can be removed from the boring head and a heavy bar of the required length inserted in its place; cutting tools can be secured in this bar by set screws for the coarse adjustments, and the finer adjustments obtained by the graduated screw on the

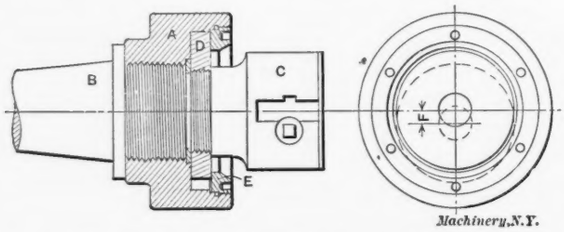


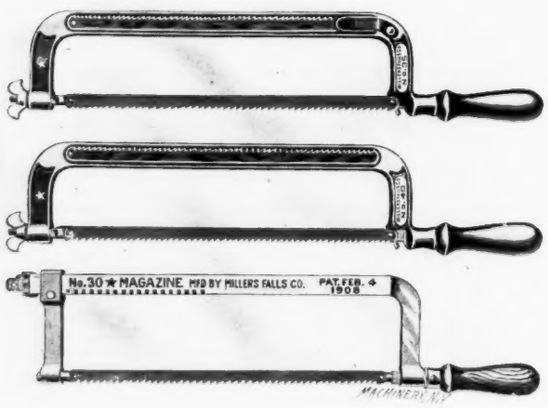
Fig. 5. Details of Construction of Eccentric Boring Head.

boring head. The head is shown thus equipped in Fig. 3, where it is being used as a stationary tool in the turret machine for a boring operation. Fig. 4 shows its use in the drill press.

It should be noted that the head allows drills or tools to be passed clear through the chuck into the spindle hole, if desired. The end of the drill chuck or boring bar is supported very close to the end of the spindle, so that very little space is required for the head. The rigid construction of the tool (which will be easily appreciated from Fig. 5) permits the use of heavy cuts, as the whole device forms practically an extension of the spindle. The Marvin & Casler Co., Canastota, N. Y., is the builder.

MILLERS FALLS CO.'S MAGAZINE HACK-SAW FRAME.

The Millers Falls Co., 28 Warren St. New York City, has devised a new form of hack-saw frame which provides a receptacle for extra blades. This provision may be truthfully described as "filling a long-felt want," as it is not uncommon to see a hack-saw frame with extra blades tied to it with a



Various Styles of Hack-saw Frames, with Provision for Carrying a Supply of Blades.

string to keep them from getting lost. The improvement will be, perhaps, more appreciated for individual than for factory use.

This hack-saw frame is made in the three styles shown in the accompanying engraving. The upper frame for 12-inch blades is made from cast iron. The magazine is formed by a deep recess cast on each side of the back of the frame, into which six 12-inch blades can be placed for storage, three on each side. The blades are held in place by a flat retaining spring. The second frame is the same as the previous one, with the exception of the provision for holding the blades in the magazine. In this case they are simply sprung into shields or pockets at the ends of the recesses. The adjustable style of frame is made to hold blades from 8 to 12 inches inclusive. These have the magazine in the back of the frame, which is hollow, being made of rectangular tubing. There is room here for a dozen blades. The depth from the back to the cutting edge is 3½ inches.

ROOT COUNTER.

The C. J. Root Co., Bristol, Conn., manufacturer of counting machines, has produced a new design which presents a number of advantages over other machines previously built. The instrument is contained within a case fastened with a Yale lock as shown, and it is so constructed that the mechanism is safeguarded against any tampering from the out-

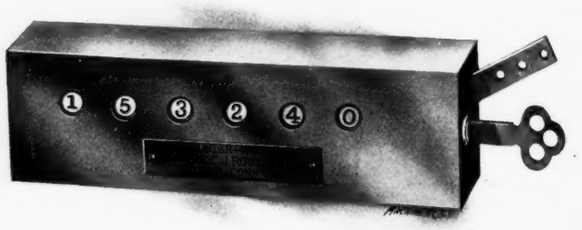


Fig. 1. The "Root" Counter, with Lock Cover to prevent Tampering.

side. It is provided with a glass cover, but even should this cover be broken, the figures cannot be changed until the apparatus is unlocked.

The mechanism is shown with the cover open in Fig. 2. As may be seen, it is of the simplest form imaginable. There are no springs and the action is positive. It is impossible for the figures to jump. It will register at any reasonable speed and lock the dials at each change of the figures. Very little power is required to move it, even when the whole six figures are changed at once. The wearing surfaces have been

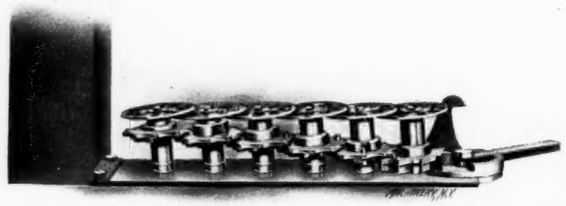


Fig. 2. Cover Raised, showing Simplicity and Positiveness of Mechanism.

reduced to a minimum. Resetting the counter is a matter of the utmost simplicity. The cover is thrown back, and each dial in turn is pulled out ¼ inch, set at the desired figure, and returned, beginning at the right-hand figure. The closing and locking of the cover again holds the dials firmly at the new setting, without any possibility of change except with the movement of the counting lever.

WALTHAM FLAT LAPPING MACHINE.

The Waltham Machine Works, Newton St., Waltham, Mass., builds the flat grinding or lapping machine shown herewith. It is intended for the finishing of flat parts on a revolving disk or lap of glass, tin, cast iron, or other material, charged with an abrasive of a kind and grade suited to the material worked and the finish desired. The principal points of interest in the machine are a solid, compact construction, every part being above the bench and easy of access; the geared drive to the work and lap spindles; and the pressure equalizing arrangement for the driving arms.

In using this machine, the work is secured (usually by shellac) to suitable cast-iron blocks such as the four seen resting on the lapping plate in the engraving. These blocks are guided by center holes in their upper faces in which are pressed center points mounted in arms on the upper shaft.

These four points are mounted on the opposite ends of two arms, pivoted on a rock shaft as shown. This rock shaft is pivoted in turn to the vertical spindle, which is provided with weights at the top to give the desired pressure between the work and the lap. The system of pivoted arms and cross-bars evidently equalizes the pressure on the four pieces of work. The weights may be changed to suit the area and material of the work being finished.

A Lapping Machine for Flat Surfaces.

The upper shaft and that carrying the lap both revolve—the former four times as fast as the latter, and in the opposite direction. This constantly changes the position of the work on the disk, and breaks up all the lines formed by the continued action of the abrasive. By swinging the head carrying the upper shaft and by adjusting the distance of the center points which guide the disks, the work may be so located that exactly the full surface of the lap is covered while in operation.

The diameter of the lapping disk is 12 inches. The weight of the machine is 365 pounds.

NEWTON VERTICAL SPINDLE ROTARY PLANING MACHINE.

The Newton Machine Tool Works, Inc., Philadelphia, Pa., has developed a vertical spindle rotary planing machine, specially adapted to machining turbine segments such as required in the building of the Curtis turbine by the General Electric Co. The machine itself, as shown in Fig. 1, has the drive applied directly to the cutter-head, by means of a pinion engaging internal teeth in a rim on its upper face. The cutter-head or face-plate gives a width of cut of 30 inches over the extreme diameter of the cutting tools. The power is furnished by a 10-H. P. motor with a speed variation of 750 to 1,000 revolutions per minute. This is connected by the spur and bevel gearing shown with the worm and worm-wheel keyed to the driving pinion.

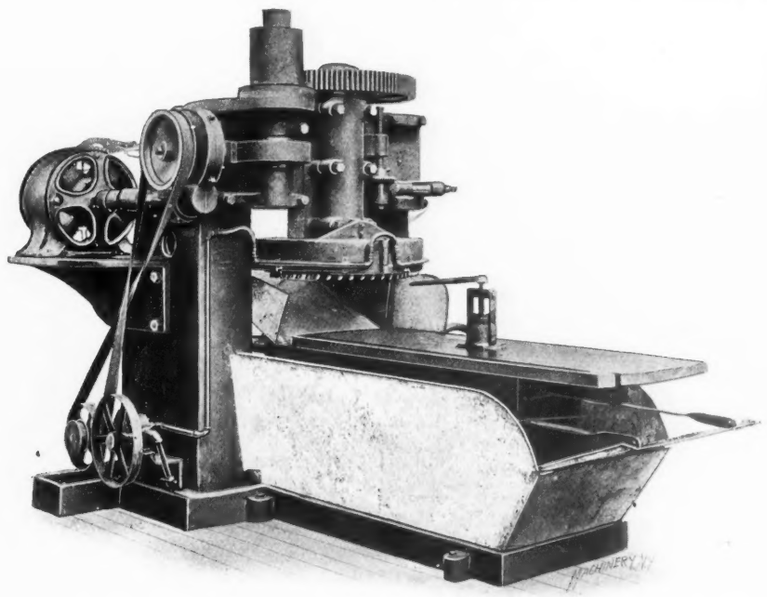


Fig. 2. Rotary Planing Machine with Revolving Table, for Changing Work while the Machine is in Operation.

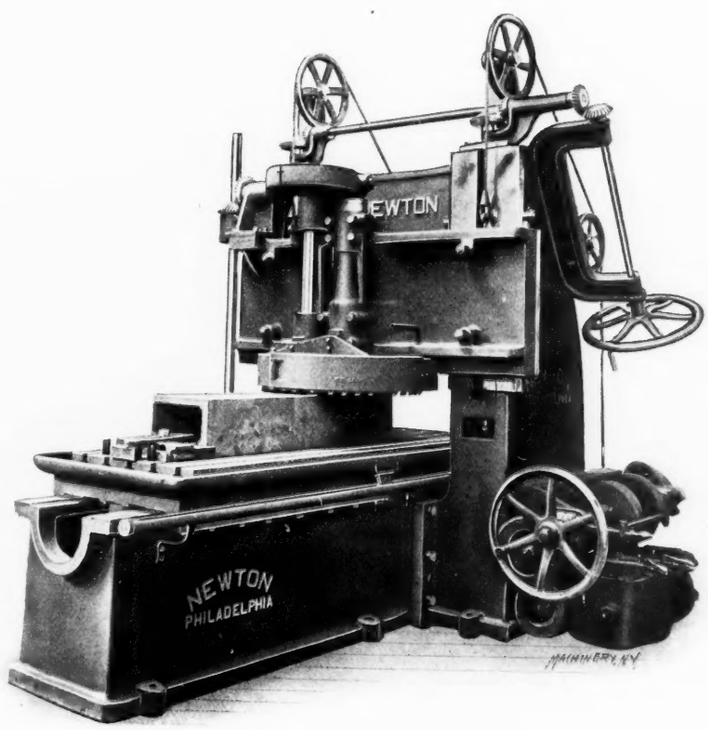


Fig. 1. Newton Vertical Spindle Rotary Planing Machine, with Adjustable Cross-rail.

The saddle which carries the spindle has a firm bearing on the upright, on which it has a hand vertical adjustment, giving a range of 8 to 26 inches from the points of the tools to the top of the work-table. The latter is 30 inches wide, and 7 feet 3 inches long, with a working surface 6 feet long. It is entirely surrounded by an oil pan. The feed movement is through a spiral gear and rack. Nine changes of geared feed are provided, ranging from 0.941 to 9.75 inches per minute. Hand adjustment and power quick return are provided, if a reversing motor is used; this gives a fast traverse in either direction. The hand-wheels for adjusting the rail and the table, and the levers for engaging the feeds and fast traverse motion, are located on the working side of the machine within easy reach of the operator.

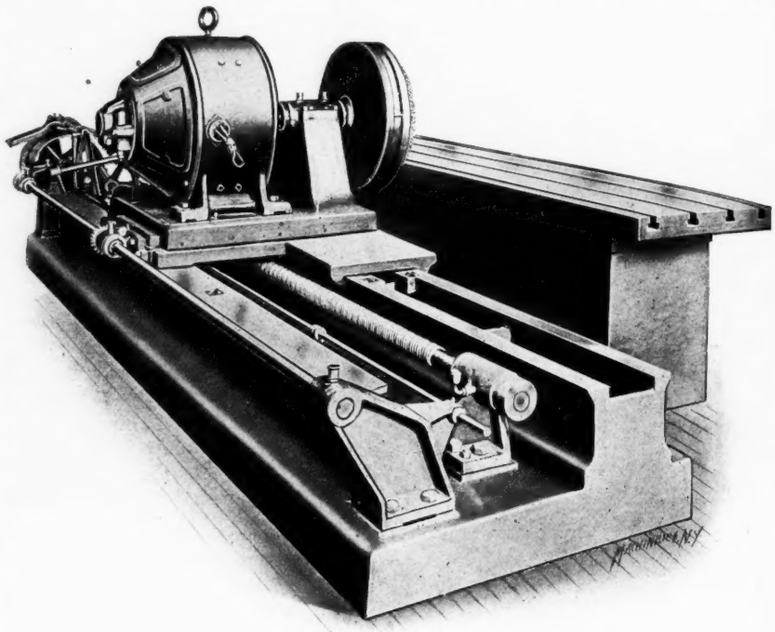
Fig. 2 shows a machine of this type provided with an auxiliary table, which may be revolved about a central pivot. This allows work to be set on one end while the work at the other end of the table is being machined. When the cut is finished the platen is run back and the table is swung half way around, presenting the new lot of work to the cutter, while the old work is in position for changing. This gives practically continuous operation.

DIAMOND MACHINE CO.'S TRAVELING-HEAD FACE GRINDER.

The heavy face grinding machine shown herewith is built by the Diamond Machine Co., of Providence, R. I., for the use of structural iron workers, bridge builders, safe makers and manufacturers in similar lines, where it is necessary to grind to close dimensions such parts as beams, columns, steel safe-plates, cast iron floor plates, etc.

As shown in the illustration, the grinding head is direct connected to an electric motor, which, together with a very heavy outboard bearing is mounted on a large base moving on ways. The motor has an extended shaft to carry the grinder chuck. The work is stationary, being bolted to the large platen in front of the 22-inch emery ring, while the ring rotates and also moves slowly back and forth from end to end of the platen. The reversing is done by a hand lever when the machine is in use, but automatic stops are provided at each end of the 8½-foot traverse, to prevent over-travel should the attendant neglect to reverse the feed. The maximum cross feed of the grinder is ½ inch, and is operated by a hand wheel and miter gear on a splined shaft in the front of the machine. The longitudinal travel of 20 feet per minute is obtained from the triple-threaded feed-screw shown; the lead screw is driven by a second motor not visible in the illustration.

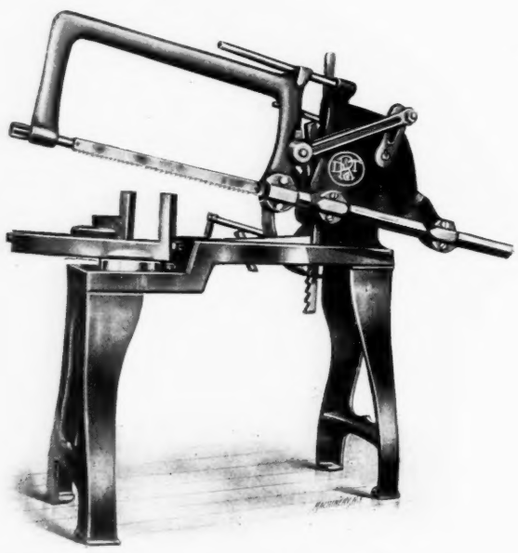
The grinder is direct connected to a standard Westinghouse totally enclosed motor, type "S" compound wound, direct current, giving 10 horse-power at 1,100 R. P. M. Where required, an alternating current motor may be supplied in place of the direct current machine. The size of the motor to operate the lead screw is dependent upon the amount of metal to be removed.



A Traveling-head Grinder for Heavy Surfacing.

ROBERTSON POWER HACK-SAW.

The power hack-saw shown herewith is made by the Robertson Drill & Tool Co., 1848 Niagara St., Buffalo, N. Y. It is called by its maker the "Royal 1909 Power Saw." It incorporates a number of improvements which will be readily understood from the following description:



Power Hack-saw made by Robertson Drill and Tool Co.

The driving mechanism is contained, as may be seen in the engraving, in a hollow gear box which is pivoted about the driving-shaft, and carries the guides for the saw-slide. The crank-shaft is connected to the drive-shaft by spur gearing inside of the gear box; the crank gives a stroke adjustable from 4 to 9 inches in length. The saw frame slides on a long, square guide, which is in line with the blade, and nearly in line with the thrust of the crank movement. This gives a smooth reciprocating action without the cramping met with in the usual construction. The feed is by gravity and means are provided for increasing the pressure as the saw wears. The saw is relieved on the return stroke. The vertical handle shown in the rear lifts the frame, while placing new work in the vise. This handle operates a notched lever, that holds the frame at any desired height in even inches, within its capacity. The frame can also be raised to a vertical position, thus providing ample space for handling large work held and conveyed by a crane.

The vise has a swiveled jaw for holding taper work, and itself swivels on the bed, being provided with graduations up to 45 degrees. This permits the taking of angular cuts. It will be noted that the bed is lowered where the vise is located. This enables the saw to be started at a good cutting angle when the largest work (8 by 8 inches) in the capacity of the machine is being operated on.

The parts are fastened together as far as possible with tongue and grooved connections, insuring first-class alignment. All plane surfaces are milled. The length of the blade used may be from 14 to 17 inches. The machine should run at from 60 to 70 strokes per minute. A high-speed design is furnished by the makers which has a tank for holding lubricant, which is pumped onto the saw. The pump is located in the head, and is geared to the driving pinion, which operates the pump only when the saw is cutting. Suitable provisions are made in the motor for straining the lubricant, and returning it to the tank for re-using.

* * *

Alteration sales are a common excuse made by a certain class of tradesmen for alleged reductions of prices. The gullible public is asked to believe that so great is the need of alterations to accommodate new stock in a growing business, that the merchant will sell his present stock at prices below cost in order to make the clearing out necessary for the changes. The fact that the business of the merchant is *selling goods* for profit and not making alterations stamps most of such claims as deceitful devices, and they insult the average intelligence, but strangely enough, though entirely unsubstantiated by logic, they are daily made the pretence of price reductions. The question is, who is most deceived, the public or the proprietors themselves. Whatever the answer is, the practice is a strange and interesting example of the confusion of cause and effect existing in the minds of a large part of apparently intelligent people.

NEW MACHINERY AND TOOLS NOTES.

ALL-STEEL SCREW-DRIVER: Billings & Spencer Co., Hartford, Conn. This screw driver is forged in one piece, including both handle and blade. The former has a shape which gives the workman a firm grip on the tool.

SECTIONAL FLANGING PRESS: Wm. H. Wood, Media, Pa. A flanging press of 200 tons capacity, adapted to the sectional flanging of work too large to be done in a single operation. Three plungers are provided, one for holding the work, one for outside flanging, and a third for reverse flanging.

TEST INDICATOR FOR LATHE WORK, etc.: Benjamin F. Ennis, 214 W. Beard Ave., Syracuse, N. Y. This tool is an indicator of sensitive construction, arranged to be conveniently used for testing the truth of internal or external revolving surfaces. It may also be used as a depth gage for comparative readings.

MOTOR-DRIVEN SAW: Crescent Machine Co., 56 Main St., Leetonia, O. In this machine the motor is mounted on an extension of the base and is directly belted to the saw arbor. The machine can be located in any position desired, independently of line shafts. It is provided with complete adjustments, making it suitable for cutting sharp tools.

"TOGGLE-GRIP" WRENCH: Lever Co., 45 Cedar St., New York. In this tool the sliding jaw is set to the desired adjustment by means of the usual knurled screw. The jaw may then be closed firmly on the work by a lever operating a toggle movement which firmly holds the wrench on the nut, without the possibility of slipping.

AUTOMATIC UNLOADER FOR AIR COMPRESSORS: Hunneymen Co., Concord, N. H. This is a device for regulating the delivery of air from the compressor to the receiver. It is operated by the variation of the receiver pressure, and controls the valve action of the compressor, being thus more economical of power than the safety valve arrangement often used.

"INDESTRUCTIBLE" FILE HANDLE: J. L. Osgood, Buffalo, N. Y. This design obviates the splitting of the handle—an accident which is liable to be dangerous, as well as costly in the aggregate. The tang is held in a steel tube, which receives all the strain of compression due to the driving in of the file. This steel tube is flanged and headed over the ferrule, which is thus held firmly in place.

THREADING TOOL: William Avery & Co., Foxboro, Mass. The design of this tool permits the swiveling of the holder in the shank to agree with the angle of the thread. The tool may be used as a solid or spring holder, at will, the change being effected by the simple removal or insertion of a pin. A tongued and grooved connection keeps the springing motion radial to the work, preventing sidewise movement.

TAIT UNIVERSAL TOOL-HOLDER: Van Doren Mfg. Co., Chicago, Ill. This holder consists of two pieces between which the cutting blade is clamped by the action of the tool face screw. These blades may be round, square or of several sections for boring, turning, parting and side tools or other forms. The holder is made in eleven sizes ranging from ¼ x ½ x 4 inches for the smallest up to 1¾ x 2¼ x 18 inches for the largest.

HEAVY LINCOLN MILLER: Hendey Machine Co., Torrington, Conn. This miller is intended for the heaviest formed cutter work for interchangeable manufacturing. The table has a working surface if 15 by 54 inches, and an automatic feed of 36 inches. Twelve feed changes are provided, in a gear box of the standard Hendey-Norton type. The cone pulley has three steps for a 4-inch belt.

The UNIVERSAL WOODWORKERS' AND PATTERNMAKERS' VISE, made by the G. M. Yost Mfg. Co., Meadville, Pa., is so constructed that it can be used in the usual method with the vise jaws flush with the edge of the bench, or it may be universally adjusted by swiveling about two axes at right angles to each other. The jaws have different forms in their different faces, to hold a variety of work. It is unnecessary to mortise the bench in mounting the vise. The jaws are 8 inches wide and 16 inches long.

AUTOMATIC CALCULATING TIME STAMP OR CHRONOGRAPH: Baird Mfg. Co., 1592 North Halstead St., Chicago, Ill. This instrument is designed to print the elapsed time on a card or ticket, and is useful in keeping track of the delivery of messages, telephone calls, and cost accounting systems of various kinds. The mechanism is simple, compact, and durable. It may be set into a desk flush with the top, with only the printing levers exposed. A ribbon is provided which is self-feeding, presenting a new and fresh surface for every impression.

SEMI-AUTOMATIC NUT BURRING MACHINE: National Machinery Co., Tiffin, Ohio. In this machine the nuts to be burred are placed by the operator in an inclined trough at the side of the machine. They are taken from the bottom of the trough and passed through the machine without further attention. The cutting head automatically adjusts itself for different thicknesses of nuts and is provided with safety trips for blank nuts, etc. As the operator does not work in close proximity to the cutters, the chance for accident is practically eliminated.

INTERNAL FIRE CONTINUOUS FURNACE: W. S. Rockwell Co., 50 Church St., New York, N. Y. This furnace is of the rotary type, provided with a grooved helical lining which feeds the material through from end to end of the furnace, as the latter revolves on the supporting rollers provided for it. The oil or gas used as a fuel is injected directly into the chamber in a direction opposite to that of the travel of the material. The machine, as will be seen, is of the continuous-action type, constantly receiving fresh parts, and delivering them at the front with the heat treatment properly applied.

GRINDER FOR SHARPENING THREADING DIES: National Machinery Co., Tiffin, O. This machine grinds the chasers for belt cutter dies in such a way as to give them the proper bevel and clearance, enabling each chaser in the set to do an equal portion of the work. This results in better threads and in lengthening the life of the die. It will sharpen any size or type of threading chasers on the market. A suitable chart is furnished for making the necessary settings for various diameters, and it is an easy matter to change from one size to another.

QUICK-ACTING TOOL-MAKERS' VISE: Mutual Machine Co., Hartford, Conn. This vise comprises a movable jaw, sliding on longitudinal rods seated in the fixed jaw, and adjustable thereon by a screw working in an adjustable yoke. The position of this yoke on the rods may be quickly changed by turning a locking disk out of engagement with ratchet-shaped teeth cut on the inner sides of the rods. This constitutes the quick-adjustment feature. All the parts are finished and hardened. The jaws measure 3 by 1¾ inches, and open out to 2 inches in width.

SIMPLEX MULTIPLE SPINDLE AUTOMATIC SCREW MACHINE: Boston Bolt Co., 40 Farnsworth St., Boston, Mass. This is an automatic screw machine designed and built in England, of which a number have been sold in this country. It is to be built here by the Boston Bolt Co. It is of the multiple spindle type, in which the turning tools are carried in a stationary head and the work spindles are mounted in an indexing drum. A feature of the machine is an adjustable feed cam by means of which the movement of the tool slide may be varied to exactly suit the dimensions of the work being turned.

ELECTRIC PYROMETER: Leeds & Northrup Co., Philadelphia, Pa. This pyrometer is of unusual construction, in that it combines the functions of an instrument of the deflection measurement type, with the accuracy and constancy of the Wheatstone Bridge method of measurement. The current used in measuring is obtained from any direct current system, and is practically independent of voltage fluctuations. A regular stock ammeter without shunt is used. The operation of measuring consists in balancing the bridge for about the desired temperature (within 200 degrees) and then reading the finer calibration on the ammeter dial.

LARGE TRAVERSING HEAD BORING MACHINE: Beaman & Smith Co., Providence, R. I. This machine is of the type in which the spindle is carried by a vertically adjustable saddle on a horizontal adjustable column or head, the work being clamped

to a suitable floor-plate. The machine is particularly interesting from its size. The spindle is 6½ inches in diameter and has a 72-inch feed. The vertical adjustment is from 2½ to 10½ feet above the table. A revolving work-table is provided, having a working surface of 6 by 8 feet. This table is revolved by a 5 horse-power motor which is also used for its adjustment lengthwise in the bed.

"PERFECTION" WRENCH: Perfection Wrench Co., Port Chester, N. Y. This wrench provides a combination of quick adjustment and toggle joint grip. In adjusting, the jaws are set to graduations. The force of the grip is controlled by turning a set-screw, which, however, does not need to be altered every time the wrench is changed from one size nut to another. The wrench may be adapted for use in piping work by removing the hardened smooth false jaws, and replacing them by hardened serrated jaws. The tool may be used as a vise also, or as a parallel drill press clamp, being finished to hold the work true on the machine platen.

HORIZONTAL BORING MACHINE: Newton Machine Tool Works, Inc., Philadelphia, Pa. This horizontal boring machine (which is also adapted for drilling and milling) is of the type in which the work-table is adjusted longitudinally and crosswise of the spindle, on an extended knee, which is, in turn, vertically adjusted on the face of the column. The particular feature of the new design is a single pulley drive. All of the feed and speed changes are effected by change gearing. Speeds range from 7 1/3 to 75 8/10 revolutions per minute and the feed changes from 0.05 to 0.115 inch per revolution of the spindle.

SINGLE-PHASE MOTORS FOR MACHINE DRIVING: Wagner Mfg. Co., St. Louis, Mo. This line of motors is particularly suited for direct connection to machine tools. The line includes designs for all frequencies from 25 to 140 cycles, and a wide range of sizes from ¼ to 40 H. P. in either a constant speed or variable speed construction. A feature of the design of these motors is the provision of an automatic governor apparatus for starting the machine with a heavy torque, on the repulsion principle. When speed has been obtained, the action of the governor transforms the rotary winding to the squirrel-cage form, after which the motor operates as a regular induction type machine.

EXCELSIOR MULTIPLE PUNCH: Excelsior Tool & Machine Co., East St. Louis, Ill. This machine bears no resemblance to an orthodox punching machine, though it performs the same work. It is intended for punching any required layout of holes in sheet iron at one operation. A horizontal die-plate, stripper plate and punch holder is provided for the full size of the sheet, with loose punches mounted in place over the die holes. A heavy and strongly supported roller is passed over the top of the punches, depressing them one after the other, as the roller comes in contact with them. This roller is set at a slight angle, so that it does not have to strike a transverse row of the punches simultaneously.

RELEASING TAP AND DIE HOLDER: Wells Bros. Co., Greenfield, Mass. This is a tap and die holder of the pull-off or releasing type. It is of unusually simple and effective construction. When threading on the work the tool is driven by a positive jaw clutch. This operates until the movement of the tool-slide stops, when the continued action of the tap or die pulls the jaws of the positive clutch out of engagement, allowing the holder to revolve freely with the work. When the spindle is reversed, a friction roller clutch of simple form takes hold, and withdraws the die, releasing again as soon as the latter starts to work on a new blank. The positive clutches are of hardened steel, securely fastened in place. The use of the friction reverse permits the parts to take hold quickly and quietly and saves the re-engagement of the positive clutch.

* * *

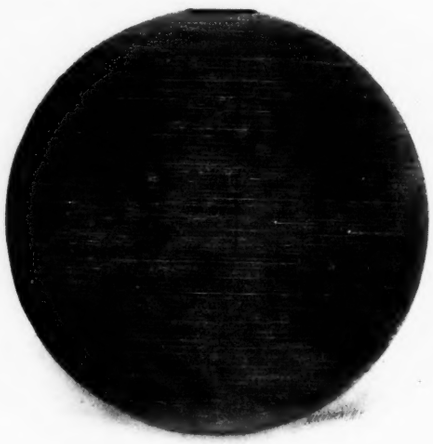
Bids for the construction of a 500-foot steel tower to be used as a wireless telegraph station at Washington have been received. When this station is in operation, it is stated that it will be possible for the Navy Department to be in constant communication with all vessels on the Atlantic seaboard.

TEST ON "STERLING" HIGH-SPEED POWER HACK-SAW.

The "Sterling" high-speed power hack-saw machine, equipped with a 17-inch "Sterling" hack-saw blade (products of the Diamond Saw and Stamping Works, Buffalo, N. Y.), cut off the 6-inch disk of machinery steel shown herewith, in one hour and fifteen minutes. The same blade was then used for cutting six disks from a 5-inch round bar of hammered axle steel, which were completed as follows:

1st cut, 25 minutes; 2nd cut, 28 minutes; 3rd cut, 32 minutes; 4th cut, 34 minutes; 5th cut, 35 minutes; 6th cut, 37 minutes.

After completing this work, the blade was taken out in good condition. The durability of its serviceableness is evident in comparing the slight increase in time required from the third to the sixth cuts. The same saws have been used to cut off sixty-pound steel rails—an operation which can be completed in from six to ten minutes.



A Six-inch Disk of Machinery Steel cut off by a "Sterling" Hack-saw Blade in 75 Minutes.

An important feature of the machine in relation to the durability of the blade, is the provision for placing it in the holder with the teeth either forward or backward, so that after one-half of the blade has been used, by reversing the saw, a fresh portion of the cutting surface is presented, thus saving nearly one-half the blades required for a machine of this capacity. The machine is also provided with a pump and lubricant and suitable draining facilities. This serves to keep the blade cool when running at high speed.

* * *

The United States Steel Corporation announced February 18 that the price of steel so firmly maintained by the company during the past few years would be cut to meet the competition of independent makers, excepting the price of steel rails. It is expected that the price of $28 for rails which has ruled for the past several years will be maintained by the five largest companies by a tacit understanding to that effect. The companies are the United States Steel Corporation, Cambria Steel Co., Lackawanna Steel Co., Bethlehem Steel Co., and the Pennsylvania Steel Co. The announcement of the cut in prices of from $4 to $7 per ton or more is followed by the threat that the wages of employes in steel mills will be reduced in all probability. The reduction of the tariff on steel products, now under consideration by Congress, is probably the reason for the cut in prices and the rumor that wages probably will be reduced.

* * *

The Delaware, Lackawanna & Western Ry. opened a new tunnel to traffic through Bergen Hill, N. J., February 14. The new tunnel contains two tracks which, with the old tunnel, makes four tracks through the hill. The new tunnel is interesting from an engineering point of view in that it is lined throughout with concrete and the rails are laid on creosoted wood ties imbedded in concrete with creosoted blocks for ballast, also laid in concrete. The tunnel is seven-eighths of a mile long.

PERSONAL.

James Duguid, machine shop foreman of the Grand Trunk Railway, Stratford, Ontario, has been promoted to the position of general foreman of the Toronto shops.

Charles Geldart, toolmaker in the Grand Trunk Railway shops, Stratford, Ontario, has been promoted to machine shop foreman, succeeding Mr. James Duguid.

John B. Guthrie has been appointed representative of the Carpenter Steel Co., Reading, Pa., in the Pittsburg district, with office in the Columbia Bank Building, Pittsburg, Pa.

John P. Cosgro has been appointed district manager of Allis-Chalmers Co., with office in El Paso & South Western Building, El Paso, Texas.

A. L. Lovejoy, formerly treasurer of the Becker-Brainard Milling Machine Co., is now manager of the sales department of Pratt & Whitney Co., New York.

J. J. Keefe, well known to the pneumatic tool trade, has entered the employ of the Independent Pneumatic Tool Co., Chicago, Ill., as sales manager, with headquarters in Chicago.

John Edgar, formerly machine tool designer with the Becker-Brainard Milling Machine Co., is employed by the Everett-Metzger-Flanders Co., Detroit, Mich., designing special machine tools for the manufacture of automobiles.

Mrs. Frances A. W. McIntosh, formerly advertising manager of the Buffalo Forge Co. and associated companies, has resigned that position and opened an office at 103 Anderson Place, Buffalo, N. Y., where she will prepare catalogues, advertising copy and general advertising literature.

Fred A. Mitchell has been appointed foreman of the tool room of the New Departure Mfg. Co., Bridgeport, Conn., succeeding Mr. Leland Nelson. Mr. Mitchell served an apprenticeship with the Pratt & Whitney Co., Hartford, Conn., and later worked for the Veeder Mfg. Co., of Hartford. He has been with the New Departure Mfg. Co. for about five years in the capacity of model-maker and foreman of the model department, which he still will supervise.

Prof. H. Wade Hibbard has resigned his position as head of the railway engineering department of Sibley College, Cornell University, to fill a similar position with the University of Missouri. Prof. Hibbard began teaching in the University of Minnesota in 1895, where he was professor of machine design and locomotive engineering. In 1898 a fund became available in Cornell University for the development of a railway engineering department, and Prof. Hibbard became a member of the faculty and developed the course.

J. E. Woodwell of the firm of L. B. Marks and J. E. Woodwell, New York City, has been retained by Messrs. McKim, Mead & White, architects, as consulting engineer for the entire mechanical and electrical equipment, including the heating and ventilation, electric lighting and power, mail handling devices, etc., of the new U. S. Post Office to be erected at the Pennsylvania Terminal Station in New York City. The automatic mail handling machinery will be a special feature of the building.

Ethan Viall, whose contributions on machine shop practice have made his name familiar to our readers, has joined the editorial force of MACHINERY to act as western traveling representative, with headquarters at Decatur, Ill. Mr. Viall is an expert with the camera and his contributions will be profusely illustrated with half-tone views, as in the past, showing shop operations, machines, tools, kinks, and the thousand-and-one devices that American manufacturers are continually bringing forth to facilitate production and reduce cost.

John S. Considine, of Columbia, Pa., has been made assistant track supervisor of the Pennsylvania Railroad Co. This promotion is important as it marks the departure of the company from a long standing rule, that ordinary track laborers could not be promoted to positions higher than track foreman, they not being considered eligible for the higher positions. The company, heretofore, has employed graduates of technical schools for official positions in maintenance-of-way and mechanical departments. Hereafter an employe not having the advantages of a college education, but who displays extraordinary ability, will be considered eligible for higher positions.

* * *

OBITUARY.

J. S. Spencer, head of the J. S. Spencer Machinery Co., Springfield, Mass., died January 18, aged fifty-eight.

Herbert Burroughs, treasurer of the Builders Iron Foundry, Providence, R. I., died suddenly at the Fort Pitt Hotel, Pittsburg, Pa., January 2, aged forty-five.

William C. Stimpson, who was head instructor in forging and foundry work at Pratt Institute, Brooklyn, N. Y., for several years, died at his home in Milford, Conn., January 13.

Otis Eddy Wood, who died in January at his home near Ithaca, N. Y., at the age of seventy-seven, is said to have been the first Morse telegraph operator who learned to read messages by sound.

Ephriam K. Smith, one of the founders of the Diamond Match Co. and maker of the first safety match produced in the United States, died in Philadelphia, Pa., February 16th, aged sixty-nine years.

George W. Shotwell, whose death was mentioned in the February issue of MACHINERY, was not president of the Diehl Mfg. Co., Elizabethport, N. J., but a member only of the family of the president, Mr. Burnett C. Kenyon.

Louis J. Atwood, president of the Plume & Atwood Mfg. Co., Waterbury, Conn., died February 22, aged eighty-two years. He was one of the pioneer manufacturers of the Naugatuck Valley and the inventor of many devices.

John F. Russell, an inventor of national reputation, died in Springfield, Ohio, February 14, aged seventy-one years. Mr. Russell was associated with William N. Whitely in the development of the modern reaper. He took out many patents including improvements on harvesting machinery, steam locomotives, etc.

Edward M. Twiss died at the Dickinson Hospital, Northampton, Mass., February 4, aged sixty-three. For many years he had been foundry superintendent of the Florence Machine Co. of Northampton, and was a very successful iron foundryman, having held important positions in other foundries.

Carroll D. Wright, president of Clark College, Worcester, Mass., died February 20th in his sixty-ninth year. Mr. Wright was noted as a statistician and for his work as United States Commissioner of Labor. He was commissioner of labor for twenty years, his term dating from 1885 to 1905.

Prof. Benjamin Franklin Clarke, Professor Emeritus of mechanical engineering at Brown University, died December 29 of pneumonia at his home in Providence, R. I. Prof. Clarke was born in Newport, Me., in 1831, and since his graduation from Brown University in 1863 has been connected with the faculty. He was twice acting president of the university.

Joseph Wharton, one of the largest individual iron manufacturers in the United States, founder of the Wharton School of Finance and Political Economy of the University of Pennsylvania, president of the American Iron and Steel Association, writer on financial, industrial and scientific subjects, died at his home in the suburbs of Philadelphia, January 11, aged eighty-three years.

W. C. Young, vice-president of the W. C. Young Machine Co., Worcester, Mass., builders of machine tools, died at his home in Worcester, January 30, in his sixtieth year. Mr. Young was well known in Worcester, having lived there for more than forty years. He had served on the city council and on the school board. The business of the company will continue as before.

David E. Harding died at his home in Mansfield, Mass., February 3, in his eighty-third year. He was born on a farm in West Mansfield, his father being one of Massachusetts pioneers, who had settled in Mansfield in 1775. In 1881 he entered into partnership with S. W. Card who was then making taps and dies. The business prospered and in 1894 it was made a stock company of which he was elected treasurer, and which office he held at the time of his death.

Edward F. C. Young was buried December 9. He was born near Morristown, N. J., in 1835 and was educated in the public schools of Jersey City. Mr. Young had been active in politics and was a director in street railway corporations and banking institutions. He is succeeded in the presidency of the Jospeh Dixon Crucible Co. by Mr. George F. Smith, vice-president. Mr. Wm. H. Corbin, counsel for the company, has been elected vice-president.

Alexander Beaudry, president and secretary of Beaudry & Co., Inc., Boston, Mass., died suddenly February 10 at his residence at Weymouth Heights, aged seventy years. He invented the first Beaudry hammer, early in the seventies, and embarked in the manufacture of it in 1880. Since then he has brought out many types of hammers and presses, having twenty-eight patents on tools of this character. The business of the company will be conducted the same as heretofore, as Mr. Beaudry's death will not in any way affect the conduct of the business. He had taken no active participation in it for the last few years.

Jose F. DeNavarro died of heart disease on February 3 at his home in New York, aged eighty-six years. He was born in Spain, graduated from the Spanish Royal Naval Academy and came to America as a teacher in the Jesuit College at Baltimore, Md. He afterward became interested in banking and transportation enterprises, and one of his most notable works was the building of the Manhattan Elevated Railroad, New York. He was the constructor of the first apartment house in New York, and was largely responsible for the establishment of the Portland cement industry in the United States, using the rotary kiln process.

WALTER M. ALLEN.

Walter M. Allen, works manager of the Warner & Swasey Co., died at his home in Cleveland, Ohio, February 8, in his forty-third year. His parents lived in Bristolville, Ohio, where he was born, and his father became engaged in the lumber business in Cleveland, but died when Mr. Allen was seven years old. Upon his father's death, his mother and three children returned to her early home in Cherryville, Me., and his early education was acquired there in the local schools. As a boy he showed great aptitude for things mechanical, but the small shops of that coast town—a box factory and a few boat works—did not satisfy his ambition. When only sixteen or seventeen years old he frequently went to the nearest railroad station, a distance of thirty miles, to study and make drawings of the locomotives that passed. When eighteen he was apprenticed to the machine trade in the works of the Warner & Swasey Co., and throughout his apprenticeship displayed great earnestness, ability and integrity. In 1891 he was made head of the drafting-room in which department he had displayed unusual ability, and during the next two years the details of design and construction of the 26-inch telescope of the Naval Observatory, and the 40-inch instrument of the Yerkes Observatory, were very largely developed under Mr. Allen's direction. In 1893 he was in charge of the firm's exhibit at the Columbian Exposition, Chicago, and on his return, when scarcely twenty-seven years old, was made superintendent of the works, which position he held with general satisfaction during the next six years. In 1904 he was made works manager, which position he held at the time of his death. The position involved not only general oversight of the works, but an active part and general responsibility in the business management as well. Mr. Allen ranked high as a designer of machinery and tools, being a man of quick perception and good judgment. He was well informed on engineering subjects generally and took an active part in planning and constructing the present new shops. He was a member of the American Society of Mechanical Engineers, Cleveland Engineering Society, Cleveland Chamber of Commerce, The Colonial Club of Cleveland, and the Automobile Club of Cleveland. He is survived by a wife and two sisters.

EDWIN REYNOLDS.

Edwin Reynolds, one of the most distinguished American mechanical engineers, died at his home in Milwaukee, Wis., February 19. Mr. Reynolds was born on a farm and learned the machinist's trade in Connecticut. In his early years he entered the employ of George H. Corliss, Providence, R. I., then the most prominent engine builder in America, and finally became general superintendent. He left the Corliss company to take charge of the E. P. Allis Co.'s works in Milwaukee, which at the time was in the hands of a receiver, to put it on a paying basis. He succeeded in doing this to a marked degree through his improvements in engines and mining machinery. The Reynolds-Corliss engine became famous as an engine of close regulation, high speed, and low steam consumption, and the works prospered. In his early career with the Allis works he took a contract for a 20 by 42 engine for the Trenton Iron Works which was required to run at 160 revolutions per minute. This high speed required a special valve gear and large ports, and the leading Corliss engine builder, George H. Corliss, would not consider the order. Reynolds built the engine successfully, and it was a great advertisement for his company. His most notable achievement, so far as the general public is concerned, was the design and construction of the great 8,000 horizontal and vertical compound engine for the Manhattan Elevated Railway power station in New York about 1900. The general features of the design of these engines were worked out by Mr. Reynolds on a railway train going to Milwaukee after having secured the contract in New York. The requirements were for great power and close regulation, and the ordinary design would have made necessary cylinders so large that it would have been very difficult to cast them without flaws and other serious defects. Mr. Reynolds conceived the idea of connecting high- and low-pressure cylinders to one crank pin and putting the generator between two sets of cylinders, the crank-pins standing 135 degrees apart. The result was a great success, as the world knows. A notable achievement in mining engineering made by Mr. Reynolds was the substitution of solid for flexible foundation under steam stamps. It had been the general practice to erect mine stamps on a springy foundation, and the result had been unsatisfactory. Mr. Reynolds very sensibly pointed out that the steam stamp was made to crush rock and that it was very poor engineering to mount it on a "feather bed," as he called it, and it was simply a matter of a solid foundation in order to get the very best effect of the blow. He took the responsibility of erecting the first steam stamp with a solid foundation, and the efficiency and durability were much increased. Mr. Reynolds was president of the American Society of Mechanical Engineers 1901-1902. He was consulting engineer of the Allis-Chalmers Co. at the time of his death.

* * *

The United States naval fleet of sixteen battleships anchored in Hampton Roads, Va., February 22, thereby completing the famous round-the-world cruise begun there December 16, 1907. The fleet doubled South America, passing through the Straits of Magellan, proceeding thence to Valparaiso, Magdelena Bay, San Francisco, Hawaii, Samoan Islands, Australia, Yokohama, Cheefoo, Suez Canal, Gibraltar, and Hampton Roads. The total distance traversed by the fleet was over 42,000 miles, and the vessels are said to be still in fit condition for further service, but, of course, they will go into dry-dock for cleaning and general repairs.

* * *

The Cunard Line steamer *Mauretania* beat all records for a day's run from Sunday noon until Monday noon, February 7-8, when she logged 671 nautical miles, making an average of 26.84 knots for the twenty-five hours.

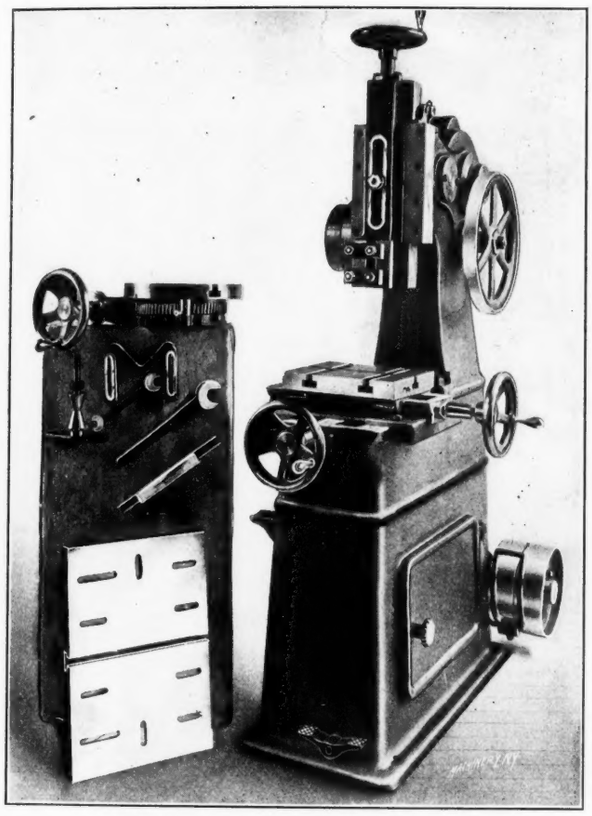
AN ENGLISH SLOTTING MACHINE.

JAMES VOSE.

The accompanying engraving illustrates a small slotting machine designed for rapid handling of the many jobs which are best dealt with on a vertical planing machine. The points of easy manipulation and large capacity have been kept in mind by the designer—Mr. A. Haworth—who has had extensive workshop experience with leading British concerns.

Though having so short a maximum stroke as 5 inches, a quick return motion is provided. The length of the guiding area of the ram is ten times its breadth. No counter-shaft is required, apart from that integral with the machine, which provides for two cutting speeds, and can be driven direct from the line-shaft. A flywheel is provided, placed at the side of the machine, so that the workman may easily adjust the position of the ram when setting work. The ram is adjustable within a range of 7½ inches by a hand-wheel and screw, while the machine is in motion.

The top slide of the table may be set central with the ram by means of a spring-backed plunger, and an attachment, shown at the left, allows work placed on the table to be self-



An English Slotter for Toolmaking and Similar Work.

centering. The tools supplied with the machine—for slotting keyways—are of a special nature, do not require forging, and are held central in a tool-holder which fits in a central groove in the face of the ram. An adjustable dead-stop enables quantities of pieces to be duplicated. A circular attachment is supplied and is provided with an index dial of 360 divisions. A spring plunger gives 2, 3, 4, 6 or 8 divisions without necessitating the use of the index dial. This attachment is extremely useful for cutting square, hexagonal, etc., internal or external shapes, in addition to circles or combinations of circular and rectilinear outlines. An auxiliary table 20 inches long and 14 inches wide is another useful extra, enabling work of a bulky outline to be clamped down for machining. A positive belt shipping arrangement, absolutely preventing self-starting, conduces to safe working by the operator.

Some of the leading capacities and dimensions are given as follows: Stroke, zero to 5-inch; depth admitted under head, 12½ inches; traverse to or from body, 14 inches, and transverse travel, 14 inches. Pulleys, gears, etc., up to 24 inches diameter can be keywayed. The surface of the top-table is 15 x 12 inches. The driving pulley is 20 inches diameter for 3-inch belt and has a speed of 240 revolutions per minute. The machine weighs about 1,230 pounds. It is built by A. Haworth & Co., Luton, England. As giving some indication of British prices for tools built in fair-sized lots, the machine illustrated, including the circular table and work-centering attachment, but not the extra table, is marketed here at about $180.

* * *

AMERICAN ANTI-ACCIDENT ASSOCIATION MEETING.

The American Anti-Accident Association held its first meeting February 11 at 215 West 23rd St., New York, with Thomas D. West, Sharpsville, Pa., presiding. The meeting was held in two sessions, the program being as follows:

Afternoon Session.—"The Fundamental Features Involving Work for the American Anti-Accident Association," by Mr. Thomas D. West; "Hoodlumism in Holiday Observance," by Mrs. Isaac L. Rice, President of the Society for the Suppression of Unnecessary Noise, New York City; "Fire Wastes Through Carelessness," by Mr. C. M. Goddard, President of the National Fire Protection Association, Boston, Mass.; "Our Shameful Lead in Railway Accidents, and the One Sure Method of Checking It," by Edward Bunnell Phelps, Editor of the *American Underwriter*, New York City; "The Child, and Accidents of our Unbridled Laxity," by Thomas D. West, President of the American Anti-Accident Association, Sharpsville, Pa.

Evening Session.—"Museum of Safety and Sanitation," with lantern slides, by Dr. William H. Tolman, Director of the American Museum of Safety, New York City; "Industrial Accidents and the Inventors," by Joseph J. O'Brien, Member of the International Congress of Inventors, Washington, D. C.; "Safety Devices in the Machine Shops and Manufacturing Plants," by Prof. John E. Sweet, Syracuse, N. Y.; "An Analysis of 5,500 Machine Shop Accidents," by Mr. L. P. Alford, Member of the Editorial Staff of the *American Machinist*, New York City; "Wage Workers' Accident Insurance and Compensation Fraternity," also Municipal Anti-Accident Boards, by Mr. Thomas D. West. The association extends a general invitation to government and municipal officials, professional men, commercial travelers, manufacturers, managers and superintendents, merchants, labor leaders, mechanics, factory inspectors, fire and life insurance officers, teachers and all other citizens to become interested in the work. The organization is due to the president, Mr. Thomas D. West, who for many years has been greatly interested in the prevention of accidents. He believes in the theory of teaching workmen to take care of themselves and to cooperate with manufacturers in the use of all devices intended to lessen the maiming and death roll in manufacturing and transportation.

* * *

The expert knowledge required to properly adjudicate patent causes, due to the growing complexity of the art, has made the need of a special court of last resort to decide patent cases, keenly felt by all concerned in such litigation. A bill has been introduced in the House of Representatives and favorably considered, for providing a special court of appeals consisting of two judges, assigned permanently, and one federal district judge, with salaries of $6,000 a year each. It is to be hoped that the bill will be passed and the special court established.

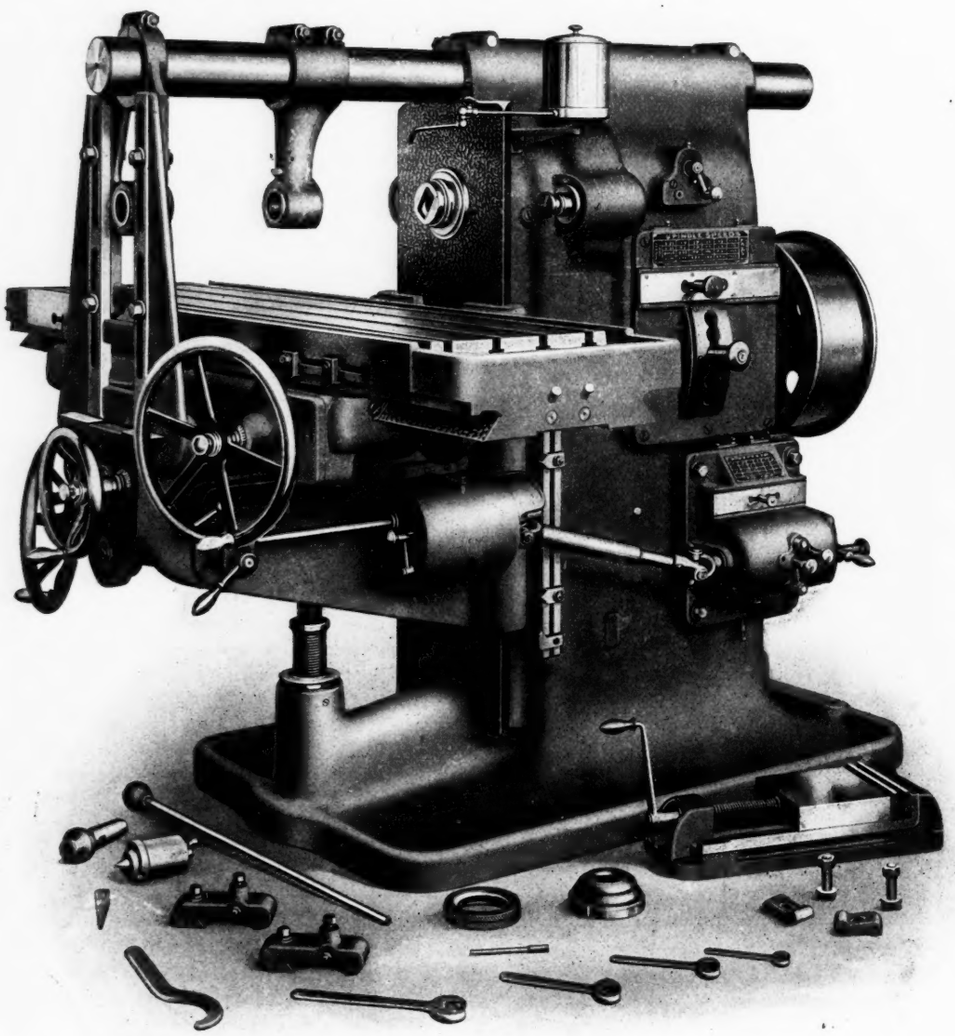
* * *

The torpedo boat destroyer *Tartar* of the English navy, using liquid fuel and steaming under war conditions, exceeded, on January 15, 38 knots an hour, thus beating her official trial record. The trial record was made in December over the official course of the Admiralty between Southampton and Maplin Sands, when the speed attained was between 35 and 36 knots an hour. Previous to this official trial, the *Tartar* made almost 36 knots an hour, beating, at that time, all records for ships of her type. The *Tartar* has been in service since April, 1907, and is a sister ship of the *Mohawk*, which also uses liquid fuel. These boats are 270 feet long, and have engines of 14,500 horse-power.

Brown & Sharpe Mfg. Co.,

The Quality and Quantity

of Work Turned Out on the B. & S. Constant Speed Drive Milling Machine is a Forcible Example of the Rigidity of its Construction.



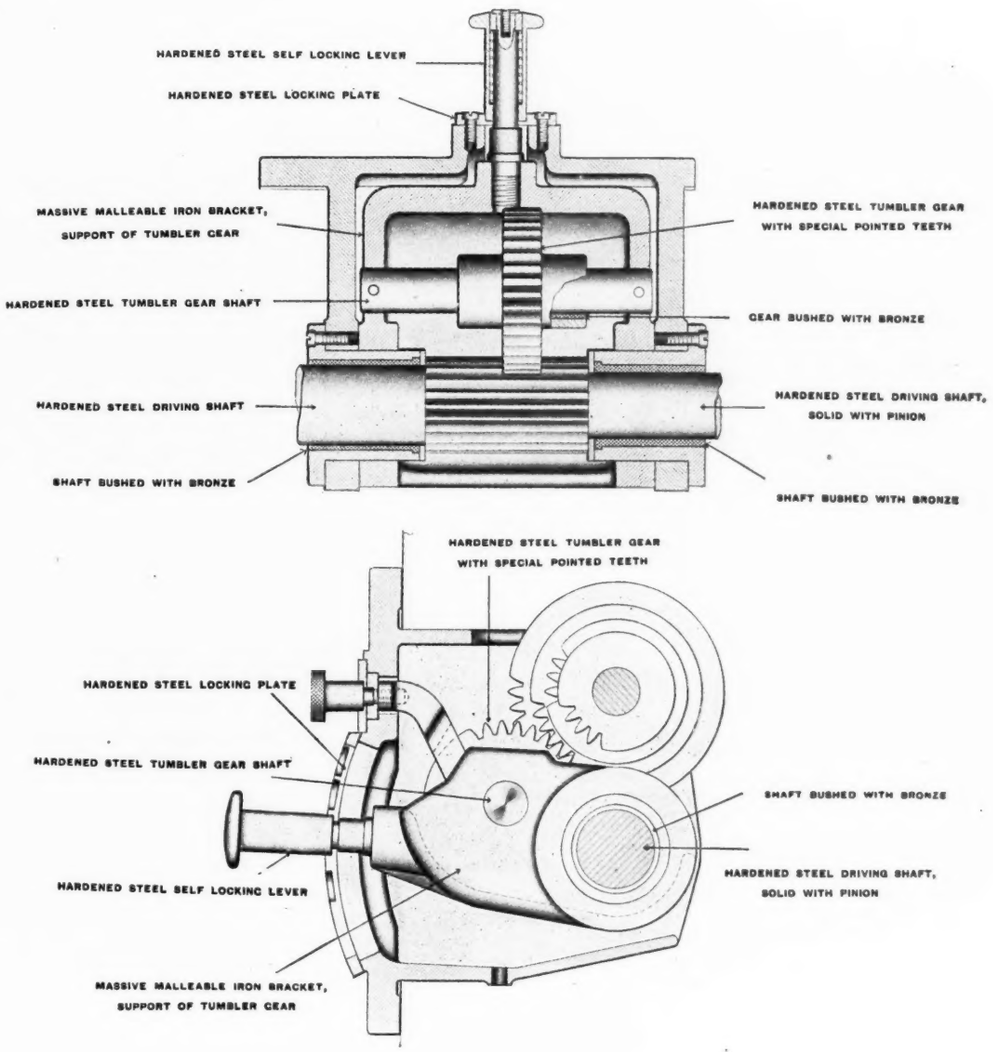
No. 5-B HEAVY PLAIN MILLING MACHINE
(SHOWN ABOVE)

THE entire line of Constant Speed Drive Milling Machines is designed for heavy service and as a whole is a striking illustration of solidity in construction. The rigid control of the moving parts as the table, saddle and knee, together with the quietness of the running gears when the machine is under heavy service show that the design is correct and solidity has been attained.

Providence, R. I., U. S. A.

Tumbler Gear Mechanism

—a Vital Part in the Construction of a Milling Machine, the Design of which is being Daily Demonstrated Mechanically and Practically Correct.


HARDENED STEEL SELF LOCKING LEVER
HARDENED STEEL LOCKING PLATE
MASSIVE MALLEABLE IRON BRACKET, SUPPORT OF TUMBLER GEAR
HARDENED STEEL TUMBLER GEAR WITH SPECIAL POINTED TEETH
HARDENED STEEL TUMBLER GEAR SHAFT
GEAR BUSHED WITH BRONZE
HARDENED STEEL DRIVING SHAFT
HARDENED STEEL DRIVING SHAFT, SOLID WITH PINION
SHAFT BUSHED WITH BRONZE
SHAFT BUSHED WITH BRONZE
HARDENED STEEL TUMBLER GEAR WITH SPECIAL POINTED TEETH
HARDENED STEEL LOCKING PLATE
HARDENED STEEL TUMBLER GEAR SHAFT
SHAFT BUSHED WITH BRONZE
HARDENED STEEL DRIVING SHAFT, SOLID WITH PINION
HARDENED STEEL SELF LOCKING LEVER
MASSIVE MALLEABLE IRON BRACKET, SUPPORT OF TUMBLER GEAR

STUDY carefully the above cuts. Note the compactness and heavy proportions of the supporting parts. All shafts are rigidly supported close to where pressure is applied. The tumbler gear itself is strongly supported in a massive malleable iron bracket trunnioned around two heavy stationary bushings, thereby resisting all twisting and cramping strains. It is locked by a heavy hardened steel self-locking lever in a massive hardened steel plate.

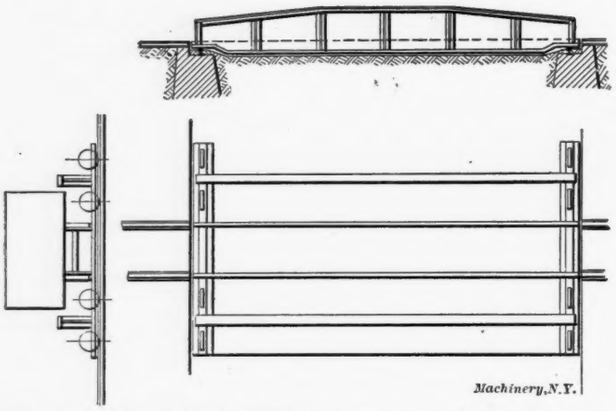
WANTED, PUBLISHED DESCRIPTION OF TRANSFER TABLE.

A reward of forty pounds sterling is offered by Messrs. Harris & Mills, 23 Southampton Buildings, London, W. C., England, to the first person handing them a public paper containing a description of a traverser of the form shown in the accompanying illustration, which complies with the following conditions:

1. The paper must have been published during the last hundred years.

2. The paper must have been published earlier than July 28, 1908.

3. It must be a public paper; according to the Patent Law of Germany any printed paper, printed book, printed lecture or printed report becomes a public paper when it has been exposed at a public library, or if it could have been bought at a bookseller's. Even a printed catalogue or printed prospectus is considered a public paper when forwarded to more than a thousand persons.



"Traverser with raised main girders on the outer side of the profile of the vehicles, moving on a track consisting of only two rails."

4. The description of the traverser, given in the said public paper, must be sufficiently clear to have enabled experts to make use of the idea to construct a similar traverser.

5. The paper must be handed in to Messrs. Harris & Mills before 3 P. M. on March 15, 1909.

6. The traverser must be like a bridge on rollers; the traverser must have raised main girders on the outer sides of the profile of the vehicle, as represented in the drawing.

7. The traverser must move on a track consisting of only two rails.

8. It is not essential whether the traverser has a pit or not. It is, however, more probable that there will be a pit.

9. The traverser may, just as well, have only four rollers instead of the eight rollers represented in the drawing.

* * *

IMPROVED HIGH-SPEED STEEL.

On another page of this issue will be found an account of an English high-speed steel that is claimed to be far superior to the other high-speed steels in general use. In the note Professor Arnold is reported as stating that in all probability every high-speed steel manufacturer in England would soon be making the same steel as the secret could not long be kept. It appears that this prediction was a fact at the time as at least one other maker was then making a water-hardened steel. We understand that "Ultra Capitol" steel, a new high-speed steel, for which George Nash & Co., New York, are the American agents, can be hardened in water and has a capacity of five to eight times the best standard high-speed steel now on the market. It is not claimed for the new steel that it will largely displace the regular grade of high-speed steel, including "Capitol" steel, because the present limitation of machine tools, makes it impossible to realize its full capacity, but it is probable that it will be used for some time to come for work that requires extreme durability of cutting edge. Of course this and other water-hardened high-speed steels will have a very marked effect on machine design, and the efforts of machine tool builders will be to develop lathes, planers, milling machines, etc., to realize the full possibilities of the new product.

* * *

CONSOLIDATION OF CINCINNATI MACHINE TOOL COMPANIES.

The Cincinnati-Bickford Tool Co., Cincinnati, Ohio, was incorporated last month for the purpose of manufacturing a full line of metal-working drilling machinery, with the following officers: August H. Tuechter, president; Sherman C. Shauer, vice-president and general manager; W. H. Shafer, secretary; George P. Gradolf, treasurer; and H. M. Norris, engineer.

This company is a combination of the Cincinnati Machine Tool Co. and the Bickford Drill and Tool Co.; and the officers of the new concern are well known in the trade, having been for many years connected with the two concerns represented in the combination, which will undoubtedly prove a potent factor in the machine tool trade as it contains all the elements of strength and progress.

* * *

The *Brass World* gives the following composition (patented by Wm. J. Leddell of Summit, N. J.) for use in making castings in metal molds: Zinc, 90 pounds; aluminum, 5 pounds; copper, 5 pounds. In cases where a harder alloy is desired, for bearings, etc., the proportions of aluminum and copper may be increased: Zinc, 87½ pounds; aluminum, 6¼ pounds; copper, 6¼ pounds. These alloys are said to have the characteristics of low shrinkage, ability to run into metal molds with sharpness, and freedom of crystallization. In addition, they have the important recommendation of being inexpensive. Where a greater fusibility is desired for castings of extreme sharpness, or where thin shapes are to be cast, the inventor advocates the use of one-half per cent or less of cadmium in the mixture. The use of metal molded castings is increasing, as many parts may be cast so accurately as not to need machining.

* * *

SOCIETY NOTES AND COMING EVENTS.

AMERICAN PEAT SOCIETY held a meeting in New York February 13, at the Chemists' Club, 108 West 55th St., New York, at which papers were presented on the value of peat as a fuel and the condition of peat production in the United States. Thousands of acres of peat lands await development which will be veritable mines of calorific value when people learn of their potential possibility.

THE AMERICAN SOCIETY OF HUNGARIAN ENGINEERS AND ARCHITECTS has been organized with the object of bringing into closer touch engineers and architects of Hungarian extraction living in this country, to give moral support and information to newcomers, and to encourage the exchange of engineering, technical and industrial information between the technical men of Hungary and of the United States. The president is A. Henry Pikler, manager of the transformer department of the Crocker-Wheeler Co., and secretary, Zoltan de Nemeth, of the New York Edison Co. The business address of the society is P. O. Box 103, New York.

March 11-12.—Annual convention of the New England Hardware Dealers' Association in Springfield, Mass. S. H. Thompson, Lowell, Mass., president.

March 27-April 3.—Mechanical and Electrical Exhibition, under the auspices of the Worcester County Mechanics' Association, in Mechanics' Hall, Worcester, Mass. The exhibition will include machinery in the operation of manufacturing goods, and is under the direction of Mr. H. F. Campbell, superintendent, room 6, Mechanics' Hall, Worcester.

May 12-14.—Annual meeting of the National Supply and Machinery Dealers' Association, at the Fort Pitt Hotel, Pittsburg, Pa. Secretary-Treasurer A. T. Anderson, 41 Wade Building, Cleveland, Ohio. The association has a membership of 141 manufacturing concerns.

September 25-October 2.—Hudson-Fulton celebration of the three-hundredth anniversary of the discovery of the Hudson River by Hendrick Hudson in 1609, and the one hundredth anniversary of the successful application of steam to the navigation of the Hudson River in 1807. The headquarters of the commission are in the Tribune Building, New York City, General Stewart L. Woodford, president, and Mr. Henry W. Sackett, secretary. The commission solicits the loan of collections of machinery, models, books, etc., having a bearing on the history of early steam navigation in the United States.

May 18-20.—American Foundrymen's Association convention. Cincinnati, Ohio, Hotel Sinton, headquarters. Richard Moldenke, secretary, Watchung, N. J.

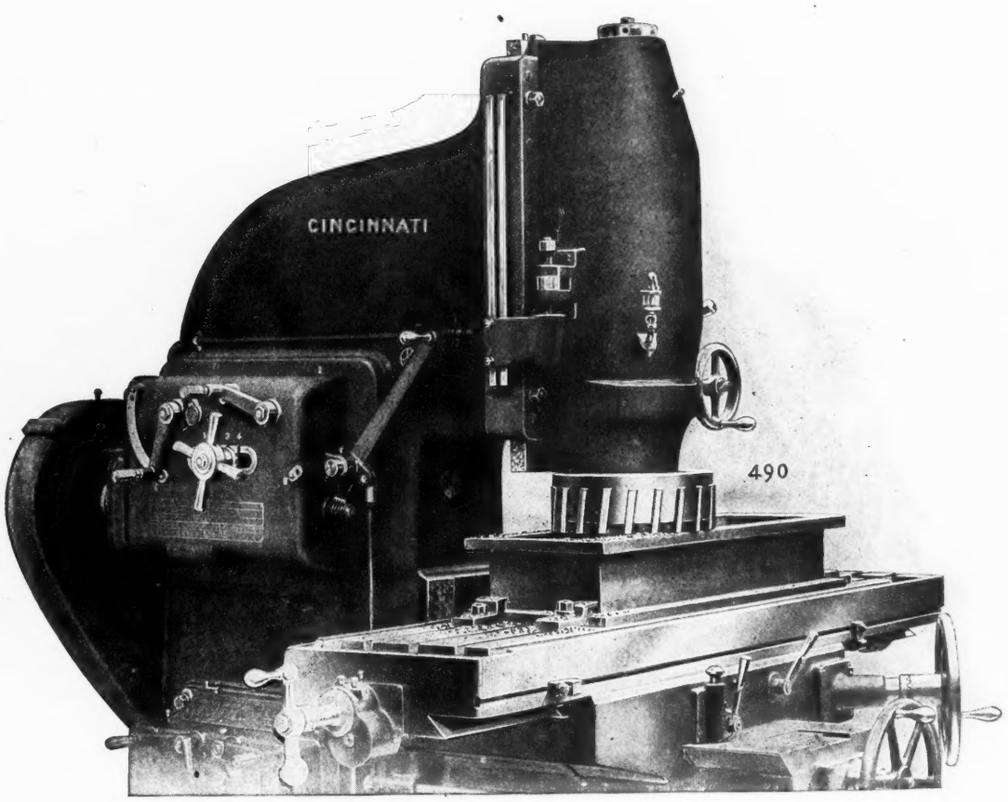
June 16-18.—Annual convention of Railway Master Mechanics' Association on Young's Million-Dollar Pier, Atlantic City, N. J. Joseph W. Taylor, Old Colony Building, Chicago, Ill., secretary.

June 16-23.—An exhibition of machinery, tools and supplies for the railway supply trade will be held under the auspices of the Railway Supply Manufacturers' Association in connection with the railway conventions at Atlantic City, N. J. Membership dues in the association are $25 per year and carry one badge only. Additional badges may be obtained by members for $5 per badge. Contracts have been let for the erection of exhibition structures covering 59,000 square feet, exclusive of aisles. The charge to exhibitors will be 40 cents per square foot, to cover the cost of erection, etc. The association has prohibited the distribution of souvenirs. Application for space should be made immediately to Mr. Earl G. F. Smith, secretary, 345 Old Colony Building, Chicago, Ill.

June 21-23.—Annual convention of the Master Car Builders' Association on Young's Million-Dollar Pier, Atlantic City, N. J. Joseph W. Taylor, Old Colony Building, Chicago, Ill., secretary.

CINCINNATI VERTICALS

HIGH POWER



Their unusual rigidity enables them to finish, at fast feeds, product of unexcelled accuracy. The pieces shown are 12" x 36"—finished surface 2" wide, gray iron.

FIRST METHOD

Cutter 12⅝" diameter takes roughing cut, then feed is reversed and finishing cut .010" deep is taken at 20" feed. Two pieces laid together show less than (.00025") one-quarter thousandth inch "out" in their length.

SECOND METHOD

A cutter 4" diameter finishes the same pieces, using cross and table feeds alternately, at 20" per minute. When laid together they show less than (.001") one thousandth inch "out" anywhere on their surface.

This is every-day commercial milling. A less rigid machine could not possibly produce this accuracy nor do the work this fast.

THE CINCINNATI MILLING MACHINE CO.

CINCINNATI, OHIO, U. S. A.

European Agents—Schuchardt & Schutte, Berlin, Vienna, Stockholm, St. Petersburg, Copenhagen and Budapest. Alfred H. Schutte, Cologne, Brussels, Liege, Milan, Paris, Turin, Barcelona and Bilbao. Charles Churchill & Co., London, Birmingham, Manchester, Newcastle-on-Tyne and Glasgow.

Canadian Agent—H. W. Petrie, Ltd., Toronto, Montreal and Vancouver.

Australian Agents—Thos. McPherson & Son, Melbourne.

NEW BOOKS AND PAMPHLETS.

HOW TO MIX PAINT. By C. Godfrey. 64 pages, 4¾ inches by 7¼ inches. 4 illustrations. Published by the Industrial Publication Co., New York. Price, 50 cents.

PRESENT STATUS OF PUBLIC EDUCATION. By Edward J. Goodwin. 16 pages, 5¾ x 9 inches. Published by the University of the State of New York, Albany, N. Y.

PROCEEDINGS OF THE TRAVELING ENGINEERS' ASSOCIATION—SIXTEENTH ANNUAL MEETING, Detroit, Michigan, August 25-28, 1908. 346 pages, 6 x 9 inches. W. O. Thompson, secretary, Buffalo, N. Y.

BULLETIN OF THE BUREAU OF LABOR. 230 pages, 6 x 9 inches, treating of industrial accidents and Mexican labor in the United States. Published by the Department of Commerce and Labor, Washington, D. C.

AMERICAN SOCIETY FOR TESTING MATERIALS; PROCEEDINGS OF THE ELEVENTH ANNUAL MEETING, held at Atlantic City, N. J., June 23-27, 1908. 706 pages, 6 x 9 inches. Published by the Society. Edgar Marburg, secretary-treasurer, University of Pennsylvania, Philadelphia, Pa.

THE GIRL AND THE MOTOR. By Hilda Ward. 111 pages, 4¼ x 6¾ inches. Published by the Gas Engine Publishing Co., Cincinnati, Ohio. Price, $1.

The book tells in story form the experiences of a young lady in the operation of a 30 H.P. automobile, and incidentally impresses some of the mechanical knowledge necessary for an amateur to acquire if he or she would successfully operate a machine.

SHORT CUTS IN CARPENTRY. By Albert Fair. 90 pages, 4¾ inches x 7½ inches. 72 illustrations. Published by the Industrial Publication Co., New York. Price, 50 cents.

The book tells how to lay out and erect carpenter work accurately. It contains a folding plate showing the interior of a house with the parts numbered and a key giving the names of the parts. The book will be found particularly useful to amateur carpenters.

MODERN CEMENT SIDEWALKS. By Charles Palliser. 64 pages, 4¾ inches x 7¼ inches. 9 illustrations. Published by the Industrial Publishing Co., New York. Price, 50 cents.

The book illustrates the construction of cement sidewalks, curbs, gutters, etc. It gives methods of testing cement, sandstone and gravel, and formulas for mixing cements, concretes and coloring same. The book contains considerable valuable information on the characteristics and use of concrete.

THE APPRENTICESHIP SYSTEM IN ITS RELATION TO INDUSTRIAL EDUCATION. By Carroll D. Wright. 116 pages, 6 x 9 inches. Published by the U. S. Bureau of Education, Washington, D. C., as Bulletin 1908: No. 6.

This pamphlet reviews the industrial situation as regards apprenticeships and apprenticeship education, and will be found of general interest to manufacturers and others concerned with the great problem of practical education and training for shopmen.

FOUNDRY PRACTICE. By James N. Tate and Melvin O. Stone. 234 pages, 5 x 7¾ inches, 112 figures. Published by John Wiley & Sons, New York. Price, $2.

This work, which now appears in the third edition, was compiled to meet the wants of instruction in foundry practice in the School of Engineering, University of Minnesota. It therefore treats of elementary foundry practice rather than of advanced ideas. The contents are devoted to green sand molding, dry sand molding, molding sand, molders' tools, molding machines and equipment, cores, core boxes, core machines, drying ovens, cupolas, blowers, melting furnaces, chilled castings, malleable castings, cleaning castings, compressed air for foundry purposes, steel castings, brass founding, cast iron alloys, etc. A feature of the work that should be generally highly appreciated is a glossary of technical terms concluding the book. The work is one that is well adapted for instruction in industrial schools and colleges, having courses in mechanical engineering.

ANNUAL REPORT OF THE SMITHSONIAN INSTITUTION, for the year ending June 30, 1907. 726 pages, 6 x 9 inches. Published by the Smithsonian Institution, Washington, D. C.

This valuable publication is much more than a report of the Smithsonian Institution; it contains, as has been the custom in past editions, reprints of valuable technical articles published in American and European journals, and abstracts of papers read before scientific societies. Among these articles may be mentioned "Steam Turbines on Land and Sea," by Charles A. Parsons; "Mechanical Composition in Printing," by Prof. A. Turpain; "Some Facts and Problems Bearing on Electric Trunk Line Operation," by Frank J. Sprague; "Recent Contributions to Electric Wave Telegraphy," by Prof. J. W. Fleming; "Progress in Electric-Metallurgy," by John B. C. Kershaw; "Recent Progress in Color Photography," by Thomas W. Smillie; "Pre-historic Japan," by Dr. E. Baels; "The Fire Piston," by Henry Balfour, etc.

GENERAL LECTURES ON ELECTRICAL ENGINEERING. By Charles Proteus Steinmetz. Edited by Joseph LeRoy Hayden. 284 pages, 6 x 9 inches. Gilt top. 48 illustrations. Published by Robson & Adee, Schenectady, N. Y. Price, $2.

The work is a collection of seventeen lectures on electrical engineering, delivered by the author before the students of Union University, Schenectady, New York, of which he is professor of electrical engineering. The lectures comprise: General Review; General Distribution; Light and Power Distribution; Load Factors and Cost of Power; Long Distance Transmission; Higher Harmonics of the Generator Wave; High Frequency Oscillations and Surges; Generation; Hunting of Synchronous Machines; Regulation and Control; Lightning Protection; Electric Railway; Electric Railway Motor Characteristics; Alternating Current Railway Motors; Electro-Chemistry; The Incandescent Lamp; Arc Lighting. The two appendixes treat of light and illumination and lightning and lightning protection. The frontispiece of the work is a fine colored photograph of the author, a feature that will be much appreciated by his friends.

ACCURATE TOOL WORK. By C. L. Goodrich and F. A. Stanley. 207 pages, 6 x 9 inches. 221 illustrations. Published by the Hill Publishing Co., New York. Price, $2.

This work will be welcomed by the high-grade tool-makers, as it treats of advanced tool-making practice in a manner not found in any other published book. Accurate tool-making practice goes hand-in-hand with interchangeable manufacturing, and, therefore, is of supreme importance. The authors treat of locating and boring holes in drill jigs, economical jig work on the milling machine, boring holes on the miller and checking with verniers, master plates and how to make them, and their uses in diemaking and the making of watch tools, trigonometry in the tool-room, measuring dovetail tool slides, gibs and V's, method of producing accurate tapers, the microscope in the tool-room and the manufacturing plant, inspection of tools, and the Swedish combination gaging system and its use. Much of the matter contained in the book has been published in the *American Machinist* and has been condensed and re-arranged for the book. The method for producing accurate tapers, by Mr. C. C. Stutz, first published in MACHINERY, February, 1899, is a system in common use by advanced tool-making concerns and is a sample of the practical character of the work.

CATALOGUES AND CIRCULARS.

WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, Pa. Catalogue of Westinghouse fan motors for 1909.

GISHOLT MACHINE CO., Madison, Wis. Leaflet illustrating the Gisholt 88-inch vertical boring mill.

PACIFIC ELECTRIC HEATING CO., Ontario, Cal. Publication entitled "Hot Points," advertising electric heated sad-irons.

"S-C" REGULATOR CO., Fostoria, Ohio. Catalogue of feed water regulator and boiler feed pump governors.

DEAN BROS. STEAM PUMP WORKS, Indianapolis, Ind. Catalogue No. 74 illustrating pumps, condensers and condensing machines.

WESTERN ELECTRIC CO., 463 West St., New York. Bulletin No. 5533 on series incandescent lighting system with tungsten lamps.

DEAN BROS. STEAM PUMP WORKS, Indianapolis, Ind. Small catalogue of 64 pages of compressors, air-pumps, condensers, circulating pumps, ammonia pumps, boiler feeders, mining pumps, etc.

MIAMI VALLEY MACHINE TOOL CO., Dayton, Ohio. Return private mailing card illustrating and advertising the Miami Valley 15-inch engine lathe.

W. R. HARRIS, Linesville, Pa., machinist and automobile repairer, requests catalogues of machine tools and machinery for shops and machine shop supplies.

HAMMACHER, SCHLEMMER & CO., Fourth Ave. and 13th St., New York, have issued a catalogue No. 262 on bolts, screws, nuts and supplies.

MUSEUM OF SAFETY AND SANITATION, 29 West 39th St., New York City. Pamphlet giving plan and scope of the organization. Dr. William H. Tolman, director and secretary.

GENERAL ELECTRIC CO., Schenectady, New York. Bulletin No. 4641 on electric light and power in the lumber and wood-working industries.

GENERAL ELECTRIC CO., Schenectady, N. Y. Bulletins Nos. 4640, 4641, and 4643, on large shell transformers, direct current instruments, and motor generators, respectively.

TATE-JONES & CO., Inc., Empire Building, Pittsburg, Pa. Testimonial letters, gotten up in lawyer's brief form, testifying to the merits of the Tate-Jones oil-burning forges and furnaces.

DUBOIS IRON WORKS, Dubois, Pa. Catalogue of Dubois single cylinder, tandem and twin tandem gas engines arranged to operate on natural, illuminating or producer gas.

JOSEPH DIXON CRUCIBLE CO., Jersey City, N. J. Booklet entitled "Lubricating the Motor," which advocates the use of graphite for lubricating internal combustion engines, steam engines, etc.

C. J. ROOT CO., Bristol, Conn. Catalogue of "Bristol," "Elm City," and "Root" counting machines which are adapted for any kind of a machine to register the number of strokes, impressions, revolutions, etc.

TATE-JONES & CO., Inc., Empire Building, Pittsburg, Pa., have been awarded a large order for the complete fuel equipment of the Coronet Phosphate Co. of Coronet, Fla., using the Kirkwood oil system, comprising burners, pumping, heating and regulating equipment.

TOLEDO ELECTRIC WELDING CO., Toledo, Ohio. Folder illustrating electric welders which are sold outright without royalty or license. These welders are made in a variety of styles and sizes to handle all classes of electric welding.

REINFORCED BRAZING & MACHINE CO., 2525 Liberty Ave., Pittsburg, Pa., which has been in the hands of the receivers, has been reorganized under the laws of Pennsylvania as the Pittsburg Reinforced Brazing & Machine Co. with a capital stock of $100,000.

KELMAN ELECTRIC & MFG. CO., 612 North Main St., Los Angeles, Cal. Booklet No. 4 on high voltage switches and oil circuit-breakers, for high tension electrical apparatus. John H. Kelman, 194 Lefferts Place, Brooklyn, New York, is the general eastern representative.

WESTINGHOUSE ELECTRIC & MFG. CO., Pittsburg, Pa. Circulars Nos. 1148 and 1158, on mercury rectifier battery charging outfits, and electric motor friction brakes, respectively. The latter apparatus is designed with particular reference to crane and hoist motors.

HESS-BRIGHT MFG. CO., 2115 Fairmount Ave., Philadelphia, Pa. Post card illustrating the international code of flag signals, and incidentally advertising Hess-Bright ball bearings, which were used on the motor boat *Dixie II*, which holds the world's record for speed.

STANDARD BRIDGE TOOL CO., Pittsburg, Pa. Catalogue of Thomas spacing tables for bridge and structural shops, boiler and tank shops, steel car plants, ship-yards, plate workers, etc. These spacing tables can be operated either automatically or by hand.

SIGHT FEED OIL PUMP CO., Milwaukee, Wis. Bulletin No. 209, illustrating the action of the Richardson automatic sight feed oil pump, model M, which provides positive automatic lubrication for each cylinder, valve, and other working parts of engines and machinery.

AMERICAN BRAKE SHOE & FOUNDRY CO., Western Union Building, Chicago, Ill. Catalogue listing manganese steel castings. The company is prepared to make manganese steel castings for all purposes, and the list includes several hundred machine parts which it has made of manganese steel.

J. W. PAXSON CO., Philadelphia, Pa. Leaflet illustrating the Paxson-Deemer side blow converter for making steel castings. It is claimed that this converter will make steel castings in any alloy or carbon required in heats of two to four tons, and twelve to fifteen heats per day per converter.

MODERN STEEL STRUCTURAL CO., Waukesha, Wis. Catalogue of electric traveling cranes, built for heavy duty in steel mills and similar plants. The catalogue reviews the construction in which great simplicity, strength, reduction of power consumption and proper proportion of parts were the special aims.

BETTENDORF AXLE CO., Davenport, Iowa. Book by Bruce V. Crandall entitled "Bettendorf Bears," illustrated in colors, advertising the Bettendorf truck arch-bar, made in one piece. The style of illustrations of the book is similar to the children's books, "Roosevelt Bears," and it is a decided novelty in advertising literature.

WILLIAM S. NICHOLLS, 254 Broadway, New York. Circular illustrating uses of Hercules portable cranes and hoists, which, made in eight sizes, range in capacity from 500 pounds to 6,000 pounds, and in weight from 10 to 1,450 pounds. The largest size has ample capacity for handling the majority of machine tools.

STANDARD ROLLER BEARING CO., Philadelphia, Pa., has expanded its sales organization by the appointment of F. N. Germane, formerly sales manager, as assistant general manager of the company; T. J. Heller, as sales manager; and F. W. Lawrence as western representative, the latter with headquarters in Chicago.

THOMAS H. DALLETT CO., 23d and York Sts., Philadelphia, Pa. Catalogue No. 10 of steam- and belt-driven air compressors. The line of compressors listed and described is new, having features of novelty and improvement. Both steam- and belt-driven machines are built single, duplex and compound with air cylinder dimensions ranging from 8 x 8 inches to 12 x 18 inches.